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# THE MOBILIZATION OF ANKYLOSED JOINTS[1]

## AN EXPERIMENTAL STUDY

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THIS experimental study was undertaken for the purpose of investigating the tissue changes which follow the interposition of certain substances between denuded joint surfaces, believing that the facts gained from such a study must ultimately form the basis for the surgical treatment of ankylosis.

Experience has proven that better results are obtained by the use of organic rather than inorganic substances, and in these experiments only organic substances were used.

Helferich (1) is credited with the first success with the interposition method. In 1893 he exhibited to the Twenty-third Congress of German Surgeons a child who had regained motion in bony ankylosis of the temporomaxillary joint after the interposition of flaps of temporal muscle. The use of muscle flaps was rapidly extended to other stiff joints by Rochet, Hoffa, Nelaton and others. Gluck (2) made use of skin flaps, Chlumsky (3) and Hoffa (4) have used non-absorbable substances, such as plates of magnesium, silver, tin, celluloid and rubber, and later Hoffa used decalcified bone. J. B. Murphy (5) used flaps of fascia that contained as much fat as possible. Kirschner (6) then demonstrated that fascia could be transplanted free and still retain its vitality, and many operators have employed free fascia transplants. W. S. Baer (7) has employed chromacized pig's bladder.

In 1905, J. B. Murphy (5) reported two experiments on animals in which the hip joints were operated upon. After destruction of the joint surfaces, a broad fascia flap with a pedicle was interposed. On dissection and microscopic study, Murphy believed that the transplanted flaps of fascia led to the formation of a new joint cavity, which he calls a bursa, and which was analogous to the normal embryological development of a joint cavity.

Recently, Sumita (8) has studied experimentally Payr's surgical treatment of ankylosis, using the hip, the knee, and the ankle joints of dogs. The joint surfaces were denuded of cartilage and pedunculated flaps of muscle, tendon, and fascia were interposed. The results were studied by X-ray, dissection, and microscopically. He finds that the interposed tissues undergo a fibrous degeneration, which leads to the formation of a cavity, which not only prevents bony union, but also

[1] Read before the American Medical Association, Section on Surgery, Minneapolis, June 19, 1913.

takes on the characteristics of a joint cavity. This he thinks is more like a ganglion, as described by Ledderhose (9) than a bursa. Sumita believes that the pressure of the bones on the interposed tissue, leading to hæmorrhage and degeneration, is the main factor in the production of this cavity. He believes also that it arises within the interposed tissue rather than around it. He also describes the interposed tissue as clinging to the denuded bone surfaces, like periosteum, thus inhibiting growth of bone. Sumita observed no marked difference in the behavior of the different tissues used, but he feels that better results follow the use of fascia than of muscle, or tendon.

Kirschner (6) has shown that free fascia transplants require very little nourishment and that they remain viable when transplanted into various tissues. Davis (10) reports the transplantation of fascia into a joint, where it remained alive, preserving its morphological characteristics. Sumita dismisses the use of free fascia transplants into joints, with the statement that Payr has not succeeded with them clinically, and that their ultimate fate is unknown.

Neff (2) reports four experimental arthroplasties on dogs, three of which died of infection. The fourth healed after the knee was excised and rectus aponeurosis was placed over the denuded femur, tibia, and patella. The dog lived four months. Dissection of the joint showed the capsule reformed and the tibia and femur separated by a pad of connective tissue, which is firmly adherent to the bone above and below. This pad contained two bursal sacs, each one half inch in diameter, and filled with clear, thick fluid. These had formed where pressure was greatest. Microscopic examination showed walls of fibrous connective tissue, in which the cells were closely packed together. There was no evidence of flattening of these cells.

In our study, the operative method was as follows in all experiments, except for slight variations which are specifically indicated. The knee joint of the dog was used on account of its easy access. After the animal was completely anæsthetized with ether, the hair was removed by saturated solution of sodium sulphide; the skin was cleaned with soap, water and alcohol and excluded from the operative field by towels immediately after incision. The joint cavity was opened by a lateral incision parallel to the patellar tendon. The patella and its tendon were displaced medianwards and turned over. The joint surface of the patella and the anterior surface of the femoral condyles were denuded of cartilage. The substance to be studied was then placed over the denuded femur and sutured in place with fine silk. The patella and its tendon were replaced. The joint was closed in layers with interrupted silk sutures. The skin was closed with Halsted's epithelial stitch. In some instances simply a collodion dressing was applied; in others, the limb was put up in semiflexed position, with dry gauze and plaster of Paris dressing. The post-operative care of all animals was such as to prevent, as much as possible, pain and suffering. All animals were sacrificed with chloroform.

Twenty-six experiments were done on twenty-five dogs. Two infected knee-joints, as well as two instances in which an operation was done at the hip, are not included in our study.

We have experimented with the following substances:

1. Cargyle's membrane.
2. Free fascia from the fascia lata.
3. Pedunculated fascia flaps.
4. Chromacized pigs' bladder (Baer).
5. Fascia impregnated with metallic silver.

Our primary object was not the study of functional results. In fact, we are inclined to doubt the possibility of producing a stiff joint by the experimental destruction of joint surfaces as above described.

In general, the point we sought to determine regarding these inserts and transplants was the behavior of the experimental joint as above described to these various substances; specifically, to determine the possibility of the interposed substance healing in, the length of time it may persist, the amount of reaction it produces, and its efficiency as a factor in the restoration of an anatomical articulation.

To obtain additional information as regards the behavior of the surrounding tissues to

these substances, we implanted them beneath the rectus abdominalis muscle.

The operative method above described produces a definite experimental condition which is as follows: Two joint surfaces, with the cartilage removed, are held in apposition, separated only by the experimental substance.

The results which follow this experimental condition without the interposition of any substance between the denuded surfaces were studied in three experiments. The following experiment alone is necessary of description:

*Experiment No. 22.* Usual operation, patella and anterior femoral surfaces denuded, joint closed with nothing interposed between denuded surfaces, slightly flexed and fixed in plaster of Paris dressing. On the sixteenth day the plaster bandage was removed. Healing had taken place per primum. On the twenty-first day the animal was sacrificed. On opening the knee joint, there was slight excess of free fluid. The patella and quadriceps tendon were adherent to femur by a mass of new-formed connective tissue.

### I. CARGYLE'S MEMBRANE

*Experiment No. 28.* Usual operation: a piece of Cargyle's membrane was interposed between the denuded femur and patella. The joint was fixed in plaster.

Fifth day: The plaster was removed. The wound was healing per primum. There was very little swelling. No discharge. The animal was sacrificed. On opening the joint, it was found that the patella and quadriceps tendon were bound to the denuded femur by a mass of granulation tissue. The inserted membrane had entirely disappeared but for a small piece imbedded in the granulation tissue.

In experiment No. 14, performed previously to the above, the animal was sacrificed at the end of ten days, at which time the inserted Cargyle's membrane had completely disappeared. The denuded joint surfaces were bound together by newly formed connective tissue.

### SUMMARY

From these experiments, it is clear that Cargyle's membrane persists in joints less than ten days. The opposed joint surfaces became united by granulation tissue, as in the experiments where no substance was interposed.

### II. FREE FASCIA TRANSPLANTS

*Experiment No. 3.* The usual operation was done on the right knee. The joint surface of the patella was sawed off. The anterior joint surface of the femoral condyles was curetted down to bare bone. A piece of fascia lata was placed over the denuded femur and sutured in position with fine silk. The joint was closed and a collodion dressing applied. No plaster was used. Another piece of fascia lata was transplanted into the abdominal wall under the rectus muscle.

Third day: Operative wounds show very little swelling and redness. No discharge.

Eighth day: The animal is beginning to put some weight on the leg.

Twenty-seventh day: Operative wounds have healed per primum. Animal walks on leg, with only a slight limp.

Twenty-ninth day: Dog sacrificed. Passive motion unimpaired. There is some grating in the joint on motion. On opening the joint cavity, there is a slight excess of fluid, slightly blood-tinged. The joint surface of the patella is smooth, but shows bare bone in spots. The patella has been slightly displaced, until it lies over the internal condyle. The denuded area on the femur is rough, but the surface is covered for the most part with a thin layer of translucent tissue. In areas, especially on the internal condyle over which the patella has rested, the bone is quite bare. The joint contains no adhesions. There is nothing in the joint which suggests a remnant of the fascia transplant.

The site of the fascia transplant in the abdominal wall was excised *en bloc*.

*Microscopical study:* Microscopical sections were prepared of the patella, the denuded femur and site of the fascia transplant in the abdominal wall. The sections of the denuded femur showed the surface quite uneven. The greater portion of the surface is covered by a layer of newly formed fibrous tissue, the cells of which are elongated and arranged in layers parallel to the free surface. In some areas the most superficial of these cells show a striking similarity to synovial membrane. In other areas the bone is quite bare. No trace of the fascia transplant is seen. The bone and the cartilage are especially interesting. Along the surface of the cancellous bone which had been denuded of its joint covering there is little or no evidence of new bone formation, the bone trabeculæ being in the same condition, apparently, as they were left at the end of the operation. Along the lateral and medial sides of the condyles, just under the joint cartilage which had not been interfered with in the operative procedure, there are small islands of new bone formation. In the groove between the condyles, small

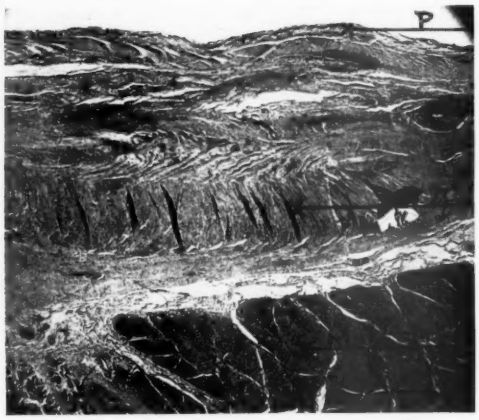


Fig. 1. Experiment No. 3. Free piece of fascia lata transplanted under the rectus abdominalis muscle twenty-eight days. T, transplanted fascia; M, rectus muscle; S, silk suture; P, peritoneum.

pieces of the joint cartilage had been left by the curette. These islands of cartilage show the normal flattened cartilage spaces changed into larger, irregular spaces, which contain several cartilage cell nuclei. Beyond this, there was no evidence of cartilage regeneration.

Sections of the patella showed the free surface to be bare bone, with no covering whatever. Attached to the patella tendon is a small tag of œdematous fibrous tissue, which may represent a small remnant of the fascia transplant.

Microscopic examination of the site of the transplantion of the fascia into the abdominal wall shows the transplant healed in so that it is continuous with the surrounding tissues. The normal histology is perfectly preserved. There is no evidence of degeneration, and no sign of any cavity formation. (Fig. 1.)

*Experiment No. 18.* The same operative procedure was carried out as in experiment No. 3. At the end of the operation the joint was dressed with dry gauze and put up in plaster of Paris in a semiflexed attitude.

Sixth day: Animal is in good condition. Plaster dressing is clean and intact.

Twentieth day: Plaster removed. Healing per primum. Animal looks thin.

Twenty-first day: The dog walks on the leg with a limp. The joint is normal in shape.

Twenty-second day: The animal has a profuse nasal discharge and a cough. Sacrificed. Passive motion unimpaired. Joint cavity contains no excess of fluid. There are no adhesions in the joint. (Fig. 2.) The joint surface of the patella is smooth. The denuded femur shows an uneven surface. Both bones are covered by a thin layer of translucent tissue. The fascia transplant has disappeared but for a small piece adherent to the joint capsule and patella tendon below the margin of the patella.

*Microscopical examination:* Sections were cut of the denuded femur and the lower margin of the patella, including the remnant of the fascia transplant. The denuded femur is entirely covered by a thin layer of newly formed fibrous tissue, growing from the narrow spaces. The most superficial cells are spindle-shaped and are arranged with their long axes parallel with the free surface. The free surface is made up of a thin layer of eosin staining material, hyaline in character. There is no evidence of regeneration of the synovial membrane. (Fig. 3.) There is no evidence of new bone formation and no sign of cartilage regeneration. The section taken for the study of the remnant of the fascia transplant passed through the lower margin of the patella, where the joint cartilage had not been entirely removed. The remnant of the transplanted fascia shows extensive degeneration. There are areas which show hyaline degeneration,

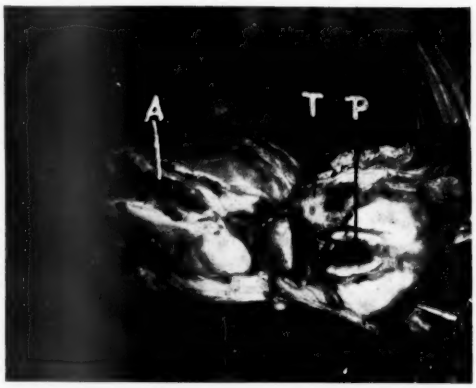


Fig. 2. Experiment No. 18. Free piece of fascia lata transplanted into joint twenty-one days. The joint has been opened by lateral and medial longitudinal incisions. The quadriceps tendon, the patella and its tendon are turned down. A, denuded area on the femur; P, patella; T, remnant of the transplanted fascia.

and others showing a massive necrosis. The whole tissue is œdematous. (Fig. 4.)

*Experiment No. 12.* The same operative procedure was carried out as in Experiment No. 18. The joint was fixed with plaster in a semiflexed attitude.

Seventh day: Dog is in good condition. Plaster undisturbed.

Fifteenth day: Plaster removed. Healing per primum. The joint was not moved and the plaster was reapplied.

Thirty-first day: Animal found dead. Autopsy showed a bilateral uterine horn infection, puerperal in origin. Passive motion in joint is fairly good. Complete extension is not possible. On opening the joint, no excess of fluid is seen. Passing between the patella and denuded portion of the femur are two short, white, fibrous-like bands, roughly 3 mm. broad and 4 mm. long. These bands are, undoubtedly, remnants of the transplanted fascia. These bands certainly limit motion in the joint, and it is easily demonstrated that motion in either direction from the angle of fixation produces tension on these bands of tissue. The denuded bones were otherwise covered with a thin layer of translucent tissue. (Fig. 5.)

*Microscopical examination:* Microscopical sections were cut of the denuded femur, so that the section passed through one of the bandlike adhesions between the femur and patella. The section shows the denuded cancellous bone to be covered over by a thin layer of fibrous tissue. Over a portion of the free surface there is a row of large, pale cells, columnar and spindle-shaped, and arranged similarly to columnar epithelium (see Fig. 6). These cells were thought to be regenerating synovial endothelium. The band of tissue which united the femur and patella is composed of a rather cellular connective tissue. At the area of its insertion into the femur the fibrous bundles of the normal fascia persist. Other than this band of tissue, there is no evidence of the persistence of the transplant. Except for a few islands of new bone under the remaining joint cartilage on the lateral and medial sides of the condyles, no new bone formation is seen.

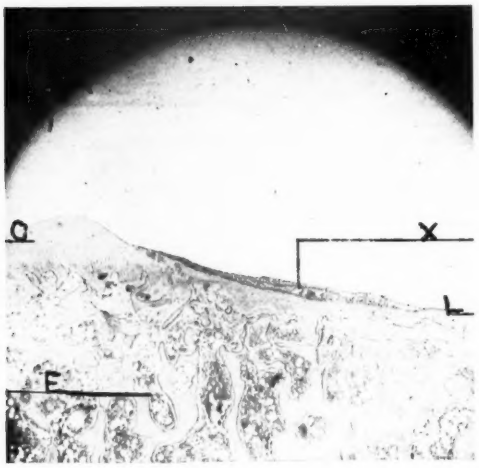


Fig. 3. Experiment No. 18. Cross section of the denuded femur shown in Fig. 2. F, cancellous bone; C, joint cartilage which was not removed from the margin of the condyle; L, layer of fibrous tissue covering the bone spicules; X, fibrinous exudate.

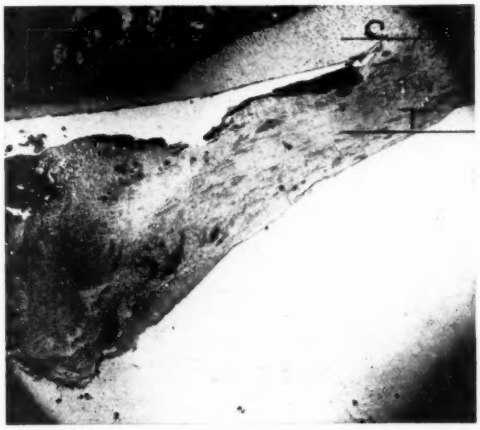


Fig. 4. Experiment No. 18. Cross section of the lower margin of the patella with the remnant of the fascia transplant as shown in Fig. 2. C, joint cartilage which was not removed from the margin of the patella; TT′, fascia transplant showing hyaline degeneration at T and actual necrosis at T′.

## SUMMARY

In experiment No. 3, in which the local post-operative conditions were observed directly, there was no discharge and very slight swelling. In experiments No. 18 and No. 12 the limb was put up in plaster of Paris dressing, but there was no evidence of any greater local reaction. In experiment No. 3 the free fascia transplant had entirely disappeared by the twenty-ninth day. In experiment No. 18 there remained only a small portion after twenty-two days, which

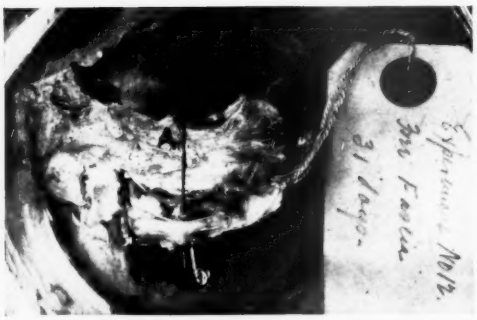

Fig. 5. Experiment No. 12. Free piece of fascia lata transplanted into the knee-joint thirty-one days. Note the small portion of the transplant (A) which has remained viable and has joined the denuded femur and patella.

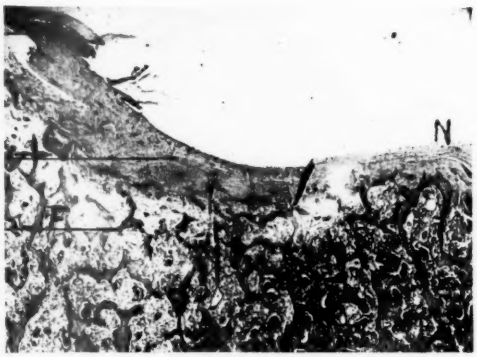


Fig. 6. Experiment No. 12. Cross section of the denuded area femur through the adhesion shown in Fig. 5. F, cancellous bone from which the joint cartilage was removed; L, layer of new-formed fibrous tissue covering the spicules of bone; N, layer of columnar cells probably proliferating endothelial cells; A, persistent part of fascia transplant which formed an adhesion between the denuded joint surfaces.

showed microscopically evidence of rapid degeneration. In experiment No. 12, after thirty-one days, the transplant persisted only in small islands which were attached to the joint surfaces, and which preserved the histological characteristics of fascia. In no instance did the entire transplant persist in the joint. This is contrary to its behavior when transplanted into soft parts, where it persists, as has been demonstrated by Kirschner, Lewis, Davis, and others, and as is shown in experiment No. 3. In experiment No. 12 the persisting islands of fascia had not covered the denuded bone as a joint surface, but had rather assumed the characteristics of adhesions between the joint surfaces. The denuded bones had in each instance been covered over with newly formed connective tissue, arising from the marrow spaces. In the two experiments in which the fascia transplant had entirely disappeared there were no adhesions between the denuded surfaces. A striking feature in each instance was the lack of new bone formation from the cancellous bone from which the cartilage had been removed. The slight new bone formation which was observed was under the cartilage which remained on the sides of the condyles.

### III. PEDUNCULATED FASCIA TRANSPLANTS

In this series of the experiments the operative procedure was in every way the same as in the free transplants, except that the piece of fascia was left attached by a broad pedicle. In the closure of the joint, great care was taken that the pedicle was not constricted. The fascia flap was dissected up, leaving the adherent fat. No attempt was made to include with the flap the subcutaneous fat.

*Experiment No. 4.* In this experiment the operative wound was dressed with a collodion dressing. No plaster was used.

Second day: Very little swelling. No discharge.

Seventh day: Wound healed per primum. The dog puts the foot to the floor occasionally, but does not use it in walking.

Twelfth day: The animal does not use the leg.

Twenty-fifth day: The dog walks on the leg with a limp.

Twenty-eighth day: Sacrificed. Passive motion in the joint good. There is some grating on motion. On opening the joint, there is a slight excess of free fluid, slightly blood-tinged. There are no adhesions between the patella and femur. The bones are, apparently, entirely covered with a thin, translucent layer of newly formed tissue. The fascia transplant has entirely disappeared, except for the pedicle, which persists as a band running from the lateral condyle to the site of the incision in the joint capsule.

*Microscopical examination:* Sections of the denuded femur show the spicules of cancellous bone covered with a layer of newly formed connective tissue, containing many blood vessels. The cells along the surface are elongated and arranged with their long axes

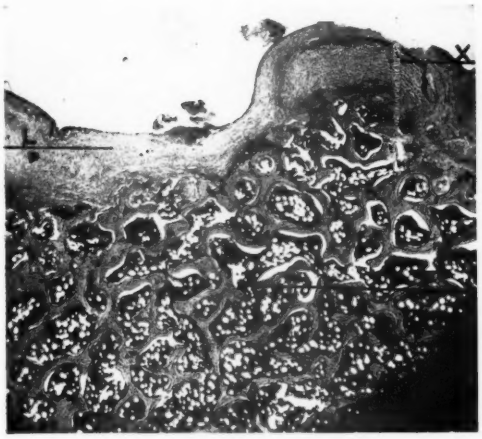


Fig. 7. Experiment No. 4. Transplantation of pedunculated flap of fascia lata into knee-joint twenty-seven days. F, cancellous bone; X, small island of the transplanted fascia which has persisted, or possibly a piece of cartilage which has undergone a fibrous change. Note that the new-formed layer of fibrous tissue (L), which has formed over the spicules of bone, also has grown over this island of tissue, illustrating the point that the free joint surface is formed by new fibrous tissue.

parallel to the surface. Lying over the spicules of bone near the middle of the denuded area there is a small island of tissue, which is evidently not newly formed tissue. This island is composed of strands and areas of a structureless hyaline-like tissue, which stains strongly with eosin. Scattered through this tissue there are elongated and triangular nuclei. Growing over the top of this island of tissue is a layer of newly formed connective tissue, which is continuous with that covering the surrounding bone. (Fig. 7.) Just what this tissue represents cannot be positively stated, but it seems most probable that it is a small island of the transplanted fascia. It may represent a small piece of cartilage which was left on the bone and which has undergone fibrous change and degeneration. The striking point, however, is the fact that in the healing process the newly formed connective tissue has covered it over so that it is entirely buried and does not form a part of the free surface. There is no new bone formation from the spicules of cancellous bone. At one margin of the denuded area under the cartilage there is a small amount of a typical bone formation.

Fig. 8. Experiment No. 13. Transplantation of a pedunculated flap of fascia lata in the knee-joint forty-two days. The joint has been opened by a median longitudinal incision and the patella tendon cut across at A. F, denuded area on the femur; Pt, patella; T, tendon; Pd, persistent pedicle of the transplant extending from the site of the operative incision to the margin of the denuded area on the femur.

*Experiment No. 13.* The same operative procedure was carried out as in experiment No. 4. At the end of the operation the joint was slightly flexed and put up in plaster of Paris.

Third day: Plaster in good condition. No swelling.

Sixteenth day: Plaster removed. Healing per primum. Plaster reapplied, without movement of the joint.

Twenty-third day: The animal has torn off the plaster bandage during the past two days. In walking the leg is occasionally used, but it is usually carried flexed.

Forty-third day: Animal does not use the leg in walking, but carries it slightly flexed. Passive motion seems good and there is apparently only a slight tendency to resist passive motion. Sacrificed. On opening the joint there is no excess of free fluid. There are no adhesions between the denuded femur and patella. The denuded areas are covered over by a thin layer of newly formed fibrous tissue. The surfaces are quite smooth. The transplanted fascia remains only as a band between the lateral margin of the femur and the site of incision in the joint capsule. (Fig. 8.) The remaining pedicle is a strong band, 1.75 cm. in breadth, which looks quite like normal fascia lata. When the joint is held flexed

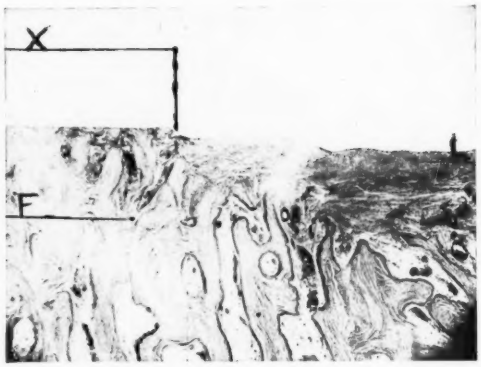


Fig. 9. Experiment No. 13. Section of the denuded area on the femur shown in Fig. 8. F, cancellous bone; L, layer of new formed fibrous tissue, which covers the bone spicules except for the elevated area to the left of X. The pressure of the overlying patella must have been borne by this elevated area. The section is reproduced for the purpose of showing the necessity of keeping the joint surfaces free from pressure in order that the bare bone may be covered over by fibrous tissue.

at an angle of 90 degrees (about the angle at which the animal held the limb), the band is under no tension. Motion in either direction from this angle produces tension on the band.

*Microscopical examination:* Sections were cut of the patella, the denuded area of the femoral condyles and of the persistent pedicle of the transplant. The femur was found to be almost completely covered over by a thin layer of newly formed connective tissue. Along the free surface, the cells are elongated and arranged in layers parallel with the surface. The superficial cells resemble very much endothelial cells. There is one small area in which the bone projects slightly above the surrounding bone, and over this elevated portion there is no connective tissue covering, the bone spicules being quite bare. (Fig. 9.)

Sections of the patella showed that the joint cartilage had not been entirely removed; a very thin layer had been left. There was no new bone formation to be seen anywhere. Sections of the remaining pedicle of the transplanted fascia showed it to be histologically the same as normal fascia lata. (Fig. 10.)

*Experiment No. 8.* The same operation as in experiment No. 4. The joint was not fixed.

Second day: Slight swelling. No discharge.

Sixth day: Wound healing per primum. Does not use the leg.

Fig. 10. Experiment No. 13. Section of the joint capsule from the site of operative incision showing the persistent pedicle of the fascia transplant shown in Fig. 8. S, silk suture; P, pedicle of the fascia transplant.

Twentieth day: Wound healed. Animal does not use the leg at all; carries it flexed. Passive motion fair.

Twenty-second day: The animal was accidentally killed in a fight. Passive motion is unimpaired. There is some grating in the joint. On opening the joint, there is an excess of free fluid. The patella and patella tendon are free. The only part of the transplant which remains is the pedicle, which forms a band which extends from the upper margin of the denuded area on the femur to the site of the incision in the joint capsule. The silk sutures marking the original area covered by the fascia remain, but there is no evidence in gross of that part of the fascia flap which covered the denuded bone. The denuded femur and patella are covered by a thin layer of translucent newly formed tissue.

*Microscopical examination:* Sections of the denuded femur and patella and of the persistent fascia pedicle were prepared. The bones were found to be covered over by a layer of newly formed connective tissue. The cells were elongated and arranged parallel to the free surface. The most superficial cells in the areas strongly resembled endothelial cells. In no place was there any evidence of the persistence of the fascia transplant over the denuded bones. (Fig. 11.)

The bones showed no new formation where the joint cartilage had been removed. Near one margin of the femoral condyles the saw

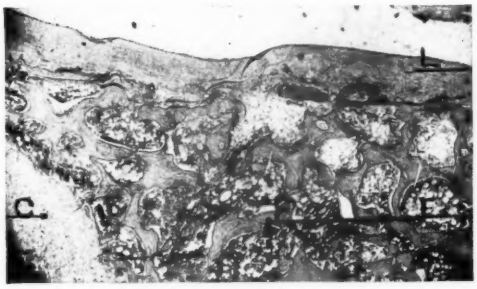


Fig. 11. Experiment No. 8. Cross section of the denuded femoral condyles twenty-eight days after transplant of a pedicled flap of fascia lata. F, cancellous bone; C, epiphyseal cartilage; L, layer of new-formed connective tissue covering the bone spicules.

had passed slightly into the epiphyseal cartilage. Here there was a small amount of newly formed bone. Also at one margin of the patella, where the saw had injured the junction of the patella and the patellar tendon, there was a small area of newly formed bone.

Sections of the remaining fascia pedicle show it to be composed of tissue histologically identical with normal fascia, except that the fibrous bundles are irregular and tortuous. Attached to the remaining piece of fascia are numerous villous-like growths composed of new connective tissue cells and covered with cells which are apparently proliferating synovial membrane.

*Experiment No. 25.* The same operation was done as in experiment No. 13. The joint was fixed in plaster.

Fifteenth day: Plaster removed. Healing per primum.

Thirtieth day: The animal is beginning to use the leg.

Fortieth day: Passive motion impaired, complete extension not possible. The dog walks on the leg with a slight limp.

Sixtieth day: Animal found dead. Passive motion possible to complete flexion. Extension is limited about 40 degrees. Contour of the joint is normal. On opening the joint, there is a discharge of a small amount of turbid mucinous fluid, which is slightly blood-tinged. The patella is seen to be joined to the medial femoral condyle by a strong band of tissue, opaque white in color. The band measures ½–1 cm. in breadth, 1½ cm. in length and approximately 1 mm. in thickness. One end is inserted over the lower one third of the denuded area on the medial condyle. The other end is

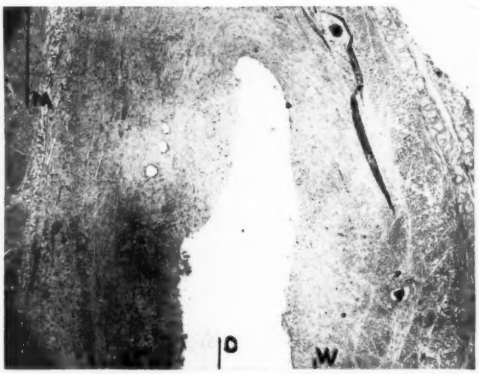


Fig. 12. Experiment No. 2. Insertion of chromacized pig's bladder membrane (Baer), under the rectus abdominalis muscle twenty-seven days. O, cavity from which the membrane has been removed; M, rectus muscle. Note the extensive inflammatory reaction in the wall (W) of the cavity.

attached to the patellar tendon just below the lower margin of the patella. The length of the band permits complete flexion in the joint without marked tension. On extending the joint, the band buckles up between the patella and the femur. There is another similar band which passes from the upper margin of the denuded area on the medial femoral condyle to the quadriceps tendon. This band measures 2 cm. in length, 1 cm. in breadth and approximately 1 mm. in thickness. One end is inserted on the upper part of the denuded medial femoral condyle for a distance of ½ cm. From this attachment the band passes anteriorly and downward to be attached to the quadriceps tendon and lateral capsule wall for a distance of 1 cm. The length of the band extending between the two structures to which it is attached measures about ½ cm. The position and the length of the free portion is such that complete flexion can be obtained without marked tension on the band. On extension, the band first relaxes, and then is pulled taut at an angle about 30–40 degrees short of complete extension.

These bands of tissue are pieces of the transplanted fascia which have, so to speak, taken root on the joint surface and are living fascia. That portion of the fascia transplant which lay over the lateral condyle has completely disappeared. The denuded bone is rough, but is covered over by a layer of newly formed connective tissue. The pedicle of the transplant remains as a band passing from the lateral margin of the lateral condyle to the site of the incision in the joint capsule.

## SUMMARY

In these experiments in which pedunculated fascia flaps were used that part of the transplant which was placed between denuded

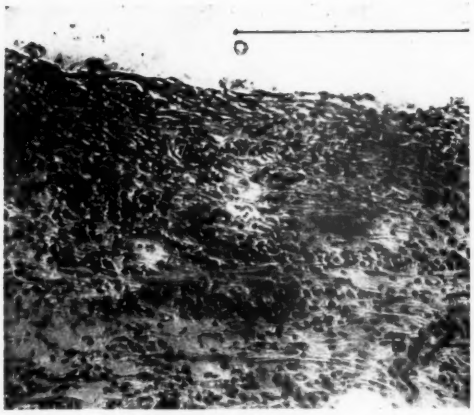


Fig. 13. Experiment No. 2. Higher power view of wall of the cavity shown in Fig. 12. O, cavity; B, growing blood vessel. Note the leucocytes and fibroblasts.

bones has acted identically as the free fascia transplants. In experiments Nos. 4, 8 and 13 this part of the transplant entirely disappeared. In experiment No. 25 the portion of the transplant which was interposed persisted in circumscribed areas as adhesions between the denuded surfaces.

In all cases the pedicle persisted within the joint as a band between the proximal margin of the denuded surface and the site of the operative incision in the joint capsule.

In each instance the denuded bones were covered over with a layer of newly formed connective tissue, which arose from the marrow spaces. No new bone formation was observed.

### IV. CHROMACIZED PIG'S BLADDER (BAER)

*Experiment No. 2.* The usual operation was performed. A piece of Baer's chromacized pig's bladder was stitched to the joint capsule, so as to lie between the denuded femur and patella. Another piece about 2 x 3 cm. was inserted under the right rectus abdominalis muscle. The joint was not put up in plaster.

Second day: Operative wound clean. Very little swelling. No discharge.

Third day: Knee joint is slightly swollen. There is a very small amount of a thin serous discharge from the abdominal wound.

Fourth day: The knee is more swollen than on the third day. There is a sense of fluctuation. Pressure on the wound causes a small amount of serous discharge. Abdominal wound swollen and discharging a small amount of clear, thin fluid.

Fifth day: Wounds not quite so swollen. No discharge from either.

Ninth day: Knee is again swollen and there is definite fluctuation. No discharge from abdominal wound.

Fourteenth day: Both operative wounds have healed. Not very much swelling. No discharge. Animal walks on the leg with a limp.

Twenty-eighth day: The animal was sacrificed. On opening the joint, the inserted membrane was found slightly doubled up between the denuded bones. Except for being more friable, the membrane appears as at the time of insertion. The denuded bones are covered with a layer of newly formed tissue. The abdominal wall was excised around the area of insertion of the membrane and hardened in formalin. On section, the inserted membrane was found lying free in a cavity which contained a cloudy fluid and the walls of which had the appearance of granulation tissue.

*Microscopical examination:* Sections of the denuded femur show that the cartilage was not entirely removed from the intercondylar groove. On the condyles, where the cartilage was completely removed, the spicules of bone are covered by a layer of newly formed fibrous tissue, which is more abundant than that seen in experiments in which other substances had been used in the

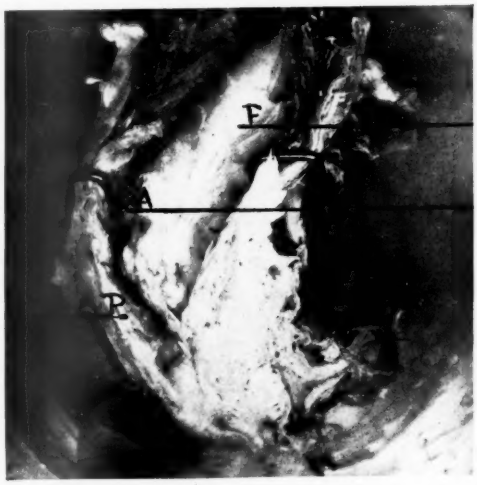


Fig. 14. Experiment No. 11. Insertion of Baer membrane in knee-joint forty days. The joint has been opened by a longitudinal incision and the patella elevated. P, patella tendon; F, femur. Note the fibrous tissue (A) which binds the patella and quadriceps tendon to denuded area on the femur.

joint. Among the connective tissue cells are numerous fibroblasts and newly formed blood vessels. On the free surface there is a layer of fibrinous exudate. Near one margin of the denuded area there is a small island of newly formed bone.

Sections were prepared of the site of the insertion of the Baer membrane into the abdominal wall. The wall of the cavity containing the insert is made up of granulation tissue. There are many fibroblasts and leucocytes. The newly formed blood vessels extend almost to the margin of the cavity wall. There is no differentiation of the border cells. The cavity in every way is similar to an abscess cavity. On careful examination a few organisms were found. No organisms found in the knee-joint section. (Figs. 12 and 13.)

*Experiment No. 11.* The same operation was done as in experiment No. 2. The joint was fixed in plaster in a slightly flexed attitude.

Fifth day: The plaster cast, which had become somewhat soiled, was removed. Wound had healed per primum. There had been no discharge. No note was made as to the amount of swelling. The joint was not moved. The plaster cast was reapplied.

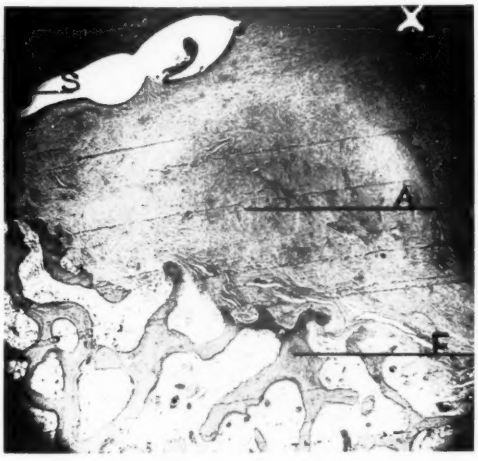


Fig. 15. Experiment No. 11. Cross section of the femur and quadriceps tendon shown in Fig. 14. F, cancellous bone; A, fibrous tissue which joins the denuded bone to the overlying patella and tendon. The patella does not show in the photograph but lies in the direction of the corner marked (X). S, small space lined with synovial endothelium. This space extends in for a short distance from the margin of the femoral condyles.

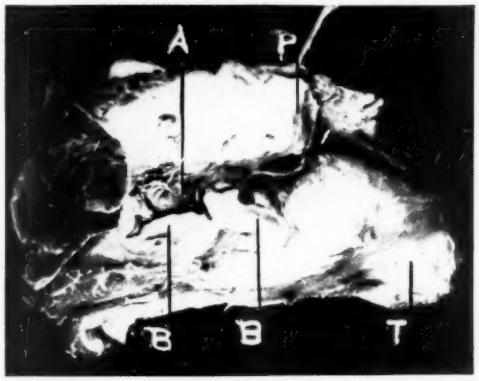


Fig. 16. Experiment No. 21. Insertion of Baer membrane in the knee-joint, seventy days. The joint has been opened by a medial longitudinal incision. T, tibia; P, patella tendon cut across; BB, masses of new-formed bone which have grown up from the margin of the femoral condyle; A, fibrous tissue adhesions between the denuded femur and overlying tendon and patella.

Thirtieth day: Animal is in good condition. Plaster cast undisturbed.

Fortieth day: The animal was sacrificed. The plaster cast was still in good shape. No functional test made. The operative wound had healed per primum. On passive movement, flexion was not limited. Extension was limited 40–45 degrees. On opening the joint, there was no excess of fluid. The inserted membrane had entirely disappeared. Between the upper half of the denuded area on the femur and the overlying quadriceps tendon there was a mass of dense fibrous tissue. (Fig. 14.) The remainder of the denuded femur is covered over with a layer of fibrous tissue, the surface of which is uneven. The patella is not adherent, but in putting up the joint in a partially flexed position, part of the patella had come to lie over the end of the femur from which the cartilage had not been removed. The joint surface of the patella is covered with newly formed connective tissue.

*Microscopical examination:* Sections were cut of the denuded femur through the area over which the quadriceps tendon was adherent. The section shows the tendon bound down to the denuded bone by a mass of fibrous tissue, which is relatively poor in blood vessels. Extending in from the lateral and median sides of the condyles there are two small slit-like spaces covered with endothelial cells, which have grown in from the walls of the joint capsule. From the spicules of the denuded bone there are a few small areas of new bone formation. Along the

Fig. 17. Experiment No. 6. Insertion of Baer membrane into the knee-joint sixty days. The joint has been opened by a longitudinal incision. The photograph is a superior anterior view. F, femur; T, quadriceps tendon; D, area from which the cartilage was removed from the femoral condyles; A, mass of fibrous tissue uniting the condyles to the overlying patella and quadriceps tendon.

Fig. 18. Experiment No. 6. Cross section of the denuded femur shown in Fig. 17. The overlying patella and tendon have been cut away. F, cancellous bone; C, cartilage which was not removed from the lateral surface of the bone and which has undergone a fibrous change; B, area of new formed bone; A, fibrous tissue. Note the absence of bone formation from the spicules of cancellous bone.

lateral and medial sides of the condyles from which the cartilage was not removed there were under the remaining cartilage larger areas of newly formed bone. (Fig. 15.)

*Experiment No. 21.* The same operation was done as in experiment No. 11. The joint was slightly flexed and put up in a plaster.

Fifteenth day: The plaster was removed. The wound had healed per primum. There had been no discharge. The joint was not moved. Plaster cast left off.

Twentieth day: Animal is in good condition. Does not use the leg. It is carried slightly flexed. Passive motion is apparently painful.

Thirtieth day: Passive motion is limited for complete extension and slightly for flexion.

Seventieth day: The animal walks on the leg, but in doing so holds the knee fixed in slight flexion. Passive motion is possible through an angle of 60 degrees. Extension limited to 30 degrees. On palpation, the patella is only slightly movable. The quadriceps tendon is fixed. On opening the joint, there is a discharge of several drops of a cloudy, mucin-like fluid. The quadriceps tendon as far down as the upper margin of the patella is attached to the denuded area of the femur by numerous bands of fibrous tissue. This newly formed scar tissue covers the entire area denuded on the femur. The patella is free, but on putting the joint in the position of fixation the patella did not lie exactly over the denuded area on the femur. The joint surface of the patella is covered by a layer of newly formed connective tissue. Growing from the lateral and medial margins of the denuded area on the femoral condyles there are two ridges of newly formed bone, approximately ½ cm. in height. This new bone formation has apparently been under the cartilage which was not removed from the sides of the condyles. (Fig. 16.)

*Experiment No. 6.* The same operation was done as in the previous experiment. The operative wound was dressed with a collodion dressing. The joint was not fixed in plaster.

Fourth day: The knee is swollen and red. No discharge.

Seventh day: The joint is discharging a thin, cloudy fluid.

Eighth day: The discharge continues. The animal does not use the leg.

Twenty-first day: The discharge has entirely ceased. The healing appears as though it had taken place per primum, as the discharge had always been from a small sinus opening. The leg is carried with the knee slightly flexed. There is still some swelling and redness.

Thirty-seventh day: Wound healed. No discharge. Leg is not used. The knee is held flexed. There is no active motion. Passive motion is limited to less than 30 degrees. The skin over the joint is still reddened.

Sixtieth day: The animal sacrificed. The knee-joint is flexed to a right angle. It is practically immobile. On opening the joint, the patella and the

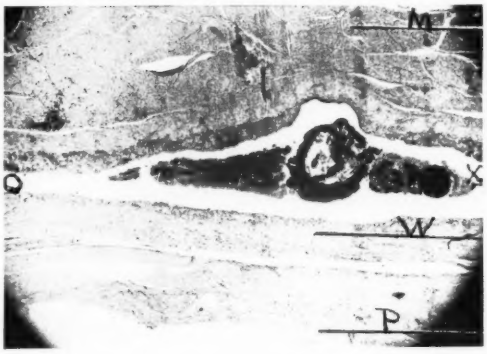


Fig. 19. Experiment No. 1. Insertion of silver impregnated fascia under the rectus abdominalis muscle thirty-seven days. M, rectus muscle; P. peritoneum; X, remnant of the inserted fascia; O, space left after absorption of part of the inserted fascia. Note the relatively narrow zone of inflammatory reaction in wall (W) of the cavity.

tendon are completely adherent to the denuded area on the femur by a mass of dense scar tissue. (Fig. 17.) The articular surfaces of the femur and tibia are quite smooth.

*Microscopical examination:* The patella and tendon were dissected from the femur by cutting through the mass of scar tissue. Microscopical sections were prepared of the denuded portion of the femur. The sections show the denuded cancellous bone spicules to be covered completely by dense fibrous tissue relatively poor in blood vessels. There is no new bone formation from the spicules of bone from which the joint cartilage had been removed. At the lateral and medial margins there are areas of new bone formation under the cartilage. (Fig. 18.)

## SUMMARY

In these experiments with the interposition of chromacized pig's bladder (Baer membrane) a conspicuous feature was the marked local reaction about the joint. In experiments Nos. 2 and 6, in which the joint was directly observed after operation, there was redness, swelling, and a discharge. In the two instances in which the experimental joint was fixed in plaster after operation (experiments Nos. 11 and 21), the amount of local redness and swelling was not observed. In these two instances there was no discharge. In experiment No. 2, in which the substance

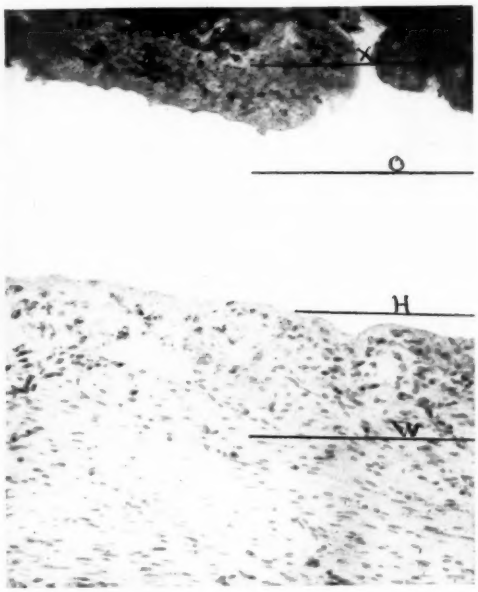


Fig. 20. Experiment No. 1. Higher power photograph of the wall of the cavity shown in Fig. 19. X, edge of the remnant of silver impregnated fascia; O, cavity; W, cavity wall. Note the arrangement of the cells and absence of marked inflammatory reaction. Also the hyaline layer (H) along the margin.

was inserted into the soft parts, there was redness, swelling, and a discharge. In experiment No. 2 the substance was present within the joint after 28 days. In experiment No. 11 it had been entirely absorbed at the end of 40 days.

The marked local reaction which followed the interposition of this substance was manifest by the presence of newly formed connective tissue, greatly in excess of that seen in any other group of experiments. In those instances in which the substance had been absorbed, this newly formed fibrous tissue had bound together the opposed joint surfaces.

In experiment No. 21, in addition to this fibrous ankylosis, there was a marked new-bone formation.

## V. SILVER IMPREGNATED FASCIA

Fascia was impregnated with metallic silver for the purpose of producing a relatively non-irritative and absorbable substance. Fascia of dogs was used because an analagous method

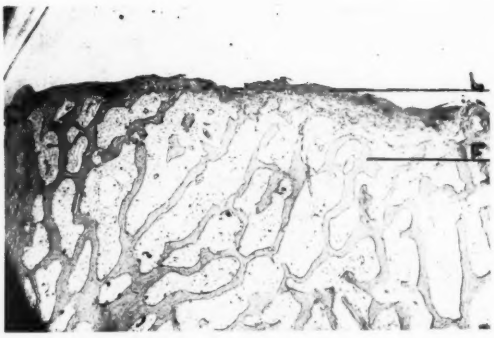

Fig. 21. Experiment No. 1. Insertion of silver impregnated fascia into the knee-joint fifteen days. Cross section of the denuded femur. F, cancellous bone; C, cartilage which was not removed from the sides of the condyles; L, layer of new-formed fibrous tissue over the bone spicules. Note the thinness of the layer of fibrous tissue covering the denuded bone and the absence of new bone formation from the spicules of cancellous bone.

of preparation and insertion may be used in the human. Silver was added because of its recognized non-irritative properties when embedded in living tissues. Metallic silver is also credited with antiseptic action.

The preparation of this substance was not a complicated process, the steps being the fixation and saturation of the fascia with a soluble silver salt and precipitating metallic silver *in situ* by a reducing agent. The excised fascia was spread out on a glass slide and dropped into 10 per cent aqueous solution of silver nitrate. The container was placed in such a position that it was exposed as much as possible to the direct sunlight, and allowed to stand for 72 hours. At the end of this time the piece of fascia was dark brown in color. It was then taken out of the solution, rinsed quickly in distilled water, and dropped into a generous quantity of 10 per cent aqueous solution of pyrogallic acid. The fascia immediately became jet black. It was left in the reducing solution 20 minutes, and then washed in running water 24 hours. Fascia put through this process is jet black in color, soft, pliable, and apparently quite as strong as when freshly excised.

For sterilization three methods were used. At first no attempt was made to keep the fascia surgically clean. After preparation it was placed between boards dried at 40 degrees centigrade and then sterilized 20 minutes in the ordinary steam sterilizer at 15 pounds pressure. This caused the fascia to shrink to almost ⅔ to ½ of its original size, and when removed from its wrapping it was quite hard and brittle. After soaking a few minutes in warm water it became quite pliable again, but a great deal of its strength was gone, so that sutures pulled through very easily. Later the piece of fascia was kept relatively clean, and after impregnating it with silver, it was soaked in bichloride of mercury solution, after which it was placed in 80 per cent alcohol until used. Finally, the fascia was kept surgically clean throughout the whole course of its preparation; that is, it was taken out with aseptic precautions. The solutions of silver nitrate and pyrogallic acid were sterilized, and the fascia handled with sterile instruments, washed with sterile water and finally placed in 80 per cent alcohol until used.

*Experiment No. 1.* The right knee-joint was opened in the usual manner, and a piece of the silver impregnated fascia was placed in the joint between the patella and femur, without any injury to the joint surfaces being done. The insert was held in position with silk sutures. Another piece was placed in the abdominal wall, under the right rectus muscle. Both operative wounds were dressed with a collodion dressing.

Seventh day: Both wounds have healed per primum, with a very slight amount of local reaction. No discharge.

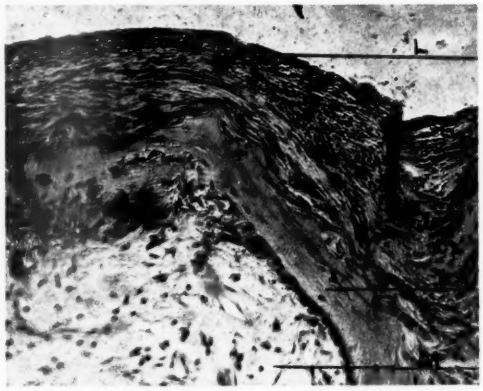

Fig. 22. Experiment No. 1. Higher power photograph of the edge of the section shown in Fig. 21. F, spicule of cancellous bone; M, marrow space; L, new-formed fibrous tissue covering the denuded bone. Note the character and arrangement of the cells.

Tenth day: Dog is walking on leg with only a slight limp.

Twenty-second day: Operative wounds have completely healed. The animal uses the knee just as on the unoperated side. The animal was anæsthetized again and the left knee opened in the usual manner. The joint surface of the patella and anterior portion of the femoral condyles were sawed off and a piece of silver fascia placed between the denuded bones. Another piece was inserted under the left rectus abdominalis muscle. Wounds were dressed with collodion. No plaster used.

Thirty-seventh day: All operative wounds healed per primum, with very little local reaction and no discharge. The animal walks on the leg operated on first with no limp. On the side operated on last there is a slight limp. The animal was sacrificed.

Left knee (15 days): Passive motion unimpaired. On opening the joint, there is a discharge of a few drops of brownish fluid. The patella and tendons are not adherent to the femur. The inserted silver fascia is seen lying over the denuded femur. The stay sutures are in place, the insert has disappeared completely over a small area in the center. The movement of the patella has apparently worn the fascia away at this point. Over the remaining denuded femur the silver membrane remains as a soft, slightly gelatinous, black covering, which can be picked off in flakes. After washing the material off, the denuded femur is found to be covered by a thin layer of translucent tissue which feels smooth. The joint surface of the patella is similar in appearance.

Right knee (37 days): There was no impairment of motion in the joint. On opening the joint, except for a slight brownish pigmentation of the joint surfaces, the joint appeared quite normal. The inserted membrane had entirely disappeared. Only the stay sutures remained, marking the site of insertion.

Fig. 23. Experiment No. 10. Insertion of silver impregnated fascia into the knee-joint forty days. The joint has been opened by a medial longitudinal incision and the capsule turned over. F, femur; P, patella tendon; A, small bandlike adhesion between the patella and middle of the denuded area on the femoral condyles.

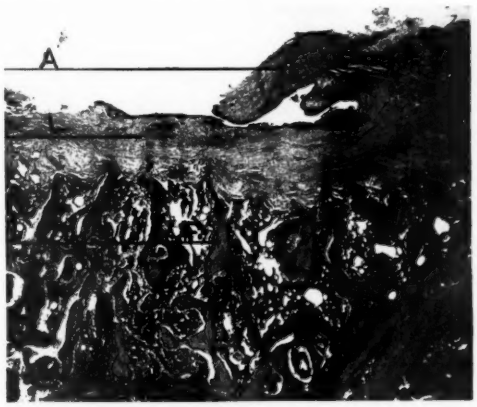


Fig. 24. Experiment No. 10. Cross section of the femur through site of the adhesion shown in Fig. 23. F, cancellous bone; E, epiphyseal cartilage; L, layer of new-formed fibrous tissue. The superficial layer has been torn away at the left of the figure in the preparation of the specimen. A, adhesion between the femur and patella.

Insertions in the abdominal wall: The sites of insertion were excised *en bloc*, fixed, and microscopic sections prepared. Sections were also cut of the denuded bones in the left knee-joint.

*Microscopical examination:* Sections of insert at the end of 15 days under the rectus muscle show that the membrane has rolled up into a mass about ½ cm. in diameter. (Note: the membrane was simply laid in the wound, no anchoring sutures being used.) The insert looks about the same thickness as when inserted. The area of reaction around the foreign substance is strikingly small. Around the insert there are numerous phagocytic cells filled with black granules. The connective tissue cells forming the cavity wall are spindle-shaped and are arranged parallel to the free edge. Along the edge there is a thin layer of hyalin-like tissue. The differentiation of the cavity lining is even more striking in the older insert and will be described with it.

Sections taken of the abdominal wall insert of thirty-seven days show the substance has disappeared but for a very small piece. This small remnant lies free in a slit-like cavity

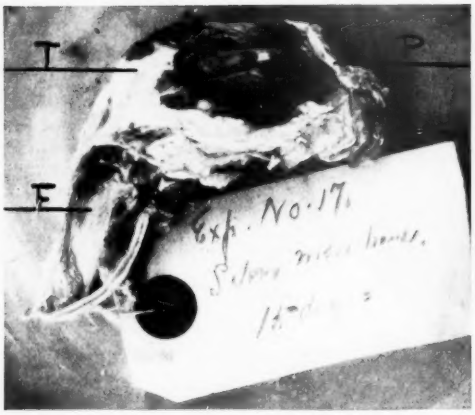


Fig. 25. Experiment No. 17. Insertion of silver impregnated fascia into the knee-joint fifteen days. The joint has been opened by a longitudinal incision and the capsule turned over. F, femur; P, patella tendon; T, quadriceps tendon. Note the black silver impregnated fascia which has partially disintegrated and is adherent to the femoral condyles and overlying patella and tendons.

which is quite as large as the inserted fascia. The walls of the cavity are composed of a thin layer of newly formed fibrous tissue, the cells of which are spindle-shaped and are of the type of the fully developed connective tissue cells. There are no fibroblasts and no new-forming blood vessels. There are no leucocytes. A few groups of lymphoid phagocytic cells contain the black silver granules. The cavity shows no evidence of being filled

Fig. 26. Experiment No. 15. Insertion of silver impregnated fascia into the knee-joints thirty-seven days. Cross section of the femoral condyles through the denuded area. F, cancellous bone; L, new-formed fibrous tissue which covers over the bone spicules except for the elevated portion (B). See Fig. 9.

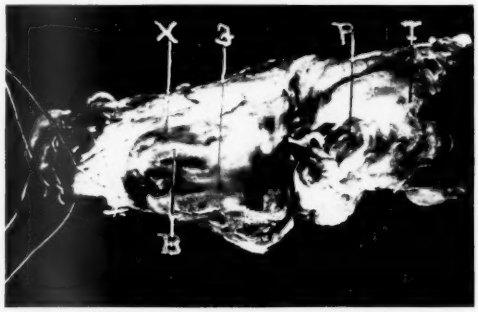


Fig. 27. Experiment No. 29. Extensive destruction of joint surfaces. Insertion of silver impregnated fascia thirty-five days. The joint has been opened by lateral and medial longitudinal incisions. The patella and tendons have been turned down. T, quadriceps tendon; P, patella. Note the smoothness of the joint surface of the femur (F) which has completely healed over with new-formed fibrous tissue except for the most prominent area (B); also the small tubercule of new-formed bone just above (X). There is also another small tubercule crossed by the line (F).

in by granulation tissue. The edge of the cavity is especially interesting. Along the margin the cells are very much elongated and show a striking resemblance to endothelial cells, both in appearance and arrangement. Along the margin there is a thin, hyalin-like substance, which stains with eosin and contains only an occasional nucleus. (Figs. 19 and 20.)

Sections of the denuded femur and patella show a very striking picture in contrast to that seen in joints in which a more irritating substance has been placed. The ends of the bone spicules remain in a plane as left by the saw. Over their surface is a thin layer of newly formed connective tissue. The cells are elongated spindle cells, arranged with their long diameter parallel to the free surface. Along the free surface the cells show a differentiation in which they resemble very closely endothelial cells, and are usually covered by the thin, hyalin-like membrane seen in the cavity produced by insertion of the substance in soft parts. (Figs. 21 and 22.) There is no new bone formation and no regeneration of cartilage.

*Experiment No. 10.* Insertion of piece of silver impregnated fascia after the usual denudation of the femur and patella. The joint was closed and put up in plaster in a semiflexed attitude.

Fortieth day: The animal has been in good condition. The plaster dressing has not been dis-

turbed. Animal sacrificed. Motion in the joint is good, except for complete extension. The limitation of extension of about 30 degrees is apparently due to contraction of the flexor muscles from the long period of fixation in plaster. The operative wound has healed per primum. The dressings show that there has been no discharge. On opening the joint, there is no excess of free fluid. The patella and the femur are seen to be joined together by a small band of newly formed fibrous tissue, about 2 mm. in width. The band passes from the middle of the patella to the central portion of the denuded area on the femur. (Fig. 23.) From the finding in experiment No. 1, it seemed possible that this adhesion could be explained by the supposition that the patella, as it were, wore a hole in the silver fascia before that active growth of granulation tissue had ceased. It is quite impossible to fix a dog's knee absolutely with plaster as the thigh muscles very quickly atrophy and loosen the plaster cast. Otherwise the joint is free of adhesions. The denuded bones are covered with a thin layer of newly formed tissue, the free surface of which is quite smooth and glistening. Except for a slight pigmentation, there is no trace of the inserted fascia.

*Microscopic examination:* Sections of the denuded bones show them to be covered entirely by a layer of newly formed connective tissue. Along the free surface there is a very thin layer of a hyalin-like material. The connective tissue cells below are spindle-shaped and are arranged parallel to the free surface. There is no evidence of new bone formation nor of regeneration of cartilage. The section was taken through the adhesion between the patella and the femur. The band is composed of newly formed fibrous tissue. Except for a few islands of pigmented cells, there is no evidence of the fascia insert. (Fig. 24.)

*Experiment No. 17.* Same operative procedure carried out as in experiment No. 10. Joint was fixed in plaster at the end of the operation.

Second day: The foot was considerably swollen. The plaster had evidently been put on too tight about the ankle. Plaster cast was split for a short distance.

Seventh day: Swelling in foot quickly subsided. The animal is in good condition.

Tenth day: Animal has distemper. Plaster is soiled, but wound looks clean.

Fourteenth day: The animal is quite sick. Profuse nasal discharge. Sacrificed. The joint shows no limitation of motion. The operative wound has healed per primum. On opening the joint, there is a discharge of a small quantity of cloudy fluid, slightly blood-tinged (probably from manipulation). The patella is quite free from the femur. There are no adhesions in the joint. The patella surface is smooth. The denuded area on the femur is covered entirely by the inserted silver fascia. The insert remains as a slightly gelatinous, friable, black mass. (Fig. 25.) In some areas this is easily removed with forceps, and in other areas it is quite firmly adherent to the denuded bone. Under the insert the bone is covered by a thin layer of granulation tissue.

*Experiment No. 15.* The same operation was done as in experiment No. 10. The joint was fixed in plaster.

Eighteenth day: The animal is in good condition. Plaster dressing undisturbed.

Thirtieth day: Dog has distemper. Wound is healed. Plaster unchanged.

Thirty-seventh day: Animal found dead. After removal of plaster, the joint was found freely movable, no limitation. On opening the joint, there was no excess of fluid. The patella and tendon were quite free from the denuded femur, except for a small threadlike adhesion extending from the superior margin of the denuded area on the femur to the quadriceps tendon just above the superior margin of the patella. The denuded bones were covered over by a thin layer of newly formed tissue, slightly stained from the black particles of silver. The inserted fascia had entirely disappeared.

*Microscopical examination:* Section of the femur shows the denuded area to be covered over with a relatively thin layer of newly formed connective tissue with the exception of one edge of the bone, which is higher than the surrounding bone, and on which probably the patella rested. This margin shows the bone quite bare. The appearance and arrangement of the connective tissue cells are similar in every respect to that seen in experiment No. 10. (Fig. 26.) There is no newly formed bone and no regeneration of cartilage.

*Experiment No. 29.* In this experiment the usual lateral incision into the joint capsule was extended upward into the quadriceps muscle, thus permitting the patella to be more completely dislocated medianwards. After the dislocation of the patella, the joint was sharply flexed and the anterior crucial ligament cut. This permitted a very good exposure of the entire joint. With a sharp curette every bit of joint cartilage which could be reached was removed from the patella, the femur, and the articular surface of the tibia. A large piece of silver impregnated fascia was then placed over the femur. The lower edge of the insert was pulled between the femur and tibia by sutures passing through the posterior wall of the joint capsule. After closure of the joint it was slightly flexed and put up in plaster.

Third day: Dog is in good condition. Plaster was not removed, but there was no marked swelling of the leg.

Seventh day: Plaster removed. Healing per primum. No swelling, no discharge. Joint was not moved. Plaster reapplied.

Tenth day: Plaster again removed. Healing per primum. No swelling, no discharge. The animal moves the joint slightly, apparently with no pain. No attempt made at passive motion.

Fifteenth day: Dog does not walk on the leg. Permits passive motion through complete range.

Twenty-fifth day: Dog walks on the leg with a slight limp. As the dog walks, the limb is not completely extended.

Twenty-eighth day: Dog walks on the leg with only a slight limp. There is slight limitation of extension. Passive motion seemingly not painful.

Thirtieth day: Dog found dead. The animal was fat and the cause of death could not be determined. After death, passive motion was free, except for complete extension. This could be obtained with slight effort. On opening the joint, there was no free fluid. Silver fascia has entirely disappeared. The joint cavity is normal in size and shape. There are no adhesions in the joint. The denuded bones are everywhere covered by a thin, translucent, smooth, shining membrane, except the top of the lateral femoral condyle near the superior end. The denudation of the bones exposed to the joint cavity has been complete, except for small islands of cartilage left on the posterior margins of the femoral condyles and the posterior margin of the head of the tibia. There is no evidence of new bone formation from the joint surfaces which were denuded. On the lateral and medial sides of the femoral condyles, from which the cartilage was not removed, there are several small tubercles of newly formed bone about 1 mm. in diameter. (Fig. 27.)

## SUMMARY

In this group of experiments in which fascia impregnated with silver was used, there was in no instance any marked local reaction; no more, in fact, than in the instances in which free fascia was interposed.

In no case was there any discharge.

In experiments Nos. 1 and 17 the substance was not entirely absorbed and still separated the denuded joint surfaces at the end of 15 days. In experiment No. 29 the substance had been entirely absorbed at the end of thirty days.

The denuded surfaces in each instance were covered over by a layer of newly formed connective tissue. The relatively small amount of this connective tissue indicated the comparatively non-irritating nature of the substance. In experiments Nos. 10 and 15 there were adhesions between the denuded surfaces which were of slight extent. In the other experiments there were no adhesions.

In experiment No. 1, in which the fascia impregnated with silver was placed in the soft parts, at the end of 37 days the substance was almost completely absorbed, leaving a cavity, the walls of which showed no evidence of closing in.

In addition to the small amount of connective tissue formation in the joints, there was in only one instance any evidence of new bone formation (experiment No. 29).

## CONCLUSIONS

1. In all the experiments the process of healing of the joint surfaces from which the cartilage was removed was the same. Following the injury the ends of the epiphyses acted in a manner strikingly different from that seen after injury to the diaphyses. There was very little new bone formation from the denuded bone area at the end of sixty days. The new bone formation seen was always under the joint cartilage which had not been removed. The denuded joint surfaces were at the end of five days covered with granulation tissue which grew from the marrow spaces. This granulation tissue developed into fibrous tissue.

2. With two denuded joint surfaces approximated directly the granulation tissue united the two surfaces. This process obviously leads to a fibrous ankylosis, which, according to Hoffa (12), is the primary stage of osseous union.

3. With the interposition of fascia lata, either in free pieces or in pedunculated flaps, the direct union of the denuded joint surfaces was prevented only in case the fascia transplant underwent necrosis and absorption. In those instances in which the transplanted fascia persisted in parts, the persistent islands acted as adhesions between the joint surfaces.

4. In the experiments with fascia there was no evidence of any advantage of a pedunculated transplant. On the contrary, in each instance the pedicle persisted as an intra-articular band which checked joint movement.

5. With the fascia fixed and impregnated with silver, the union of the denuded joint surfaces was prevented.

6. The more irritating chromacized pig's bladder membrane always led to a much greater amount of fibrous tissue formation, and the fibrous tissue formed in every instance more or less completely united the opposed joint surfaces.

7. The relatively small amount of new bone formation from the ends of the bones in the joint makes the prevention of union between raw joint surfaces a problem which is identical with that of cavity production in soft parts. With the transplantation of living tissue into soft parts, in case the transplant preserves its vitality, it heals in the tissues without cavity formation. If the insert undergoes necrosis and absorption, or is an absorbable, non-living substance which excites very little inflammatory reaction, it disappears, leaving a cavity. If the insert is of such a nature as to set up a marked inflammatory reaction, the tendency of the process is to close the cavity occupied by the insert in a manner similar to the closing of an abscess cavity.

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# THE END RESULTS OF ATTEMPTS TO MOBILIZE STIFFENED JOINTS

By ROBERT B. OSGOOD, M. D., Boston

THIS report is made with some reluctance, because in the majority of cases the results of the attempts at the mobilization of stiffened joints which have been made by the writer have been far from satisfactory. At the outset it must be understood that no criticism is intended of the work of other men who have been more successful in their attempts. Rather are these happy results evidence of greater skill. If the honesty of endeavor need not be questioned, it seems fair to report a small series of cases which may be classed as failures in the hands of one who has been fortunate enough to have had an ample surgical training, lacking though he may be in technique.

One of the maxims of surgery must be still, *Primum non nocere*. The report of failures which have resulted from at least considerate attempts may aid good judgment.

In a recent number of the Journal of the American Medical Association will be found the report of a paper read before a prominent state medical society on "Post-Rheumatic Ankylosis." The writer of this paper is reported to have said, "In aggravated cases of post-rheumatic ankylosis in which there is osseous union it becomes *necessary* to resort to arthroplastic operations. When an arthroplastic operation is correctly performed in a suitable case and the proper after-treatment is carried out, there is a reasonable assurance that the patient will have a freely movable joint, free from pain, and which will support weight and withstand traction." Large loopholes are left in this statement by the limiting phrases, "correctly performed" and "suitable case," but in spite of these, there can be no doubt as to the impression given that arthroplasty is no longer in the experimental stage, but that on the other hand all the different joints may be subjected to this operation by any good surgeon and that "there is a reasonable assurance that the patient will have a freely movable joint free from pain and which will support weight." The author may not have been correctly reported, but such a report in our opinion may be productive of much harmful surgery. By personal observation and personal conversation, we have tried to obtain a fair idea of the results at present to be expected in the hands of the most experienced and skillful advocates of these operations, and no such rosy prognosis is warrantable. The extreme of optimism is represented by the attitude of J. B. Murphy, and the extreme of conservatism by Lorenz.

In no way do we wish to be understood as discouraging further attempts. We still possess enthusiasm for perfecting technique and appreciate the great advances which have been made. We are inclined to believe, however, in the light of such a series as those reported, which we believe may be duplicated in the hands of other surgeons, that unilateral, painless, bony ankylosis of the knee, hip, shoulder, and possibly elbow, should be submitted to arthroplastic operations at the present stage of our technique only after a free discussion with the patient and a realization on his part of the prolonged and often painful after-treatment, and the somewhat uncertain nature of the results. We urge as far as possible the concentration of these cases in the hands of a few men, preferably only one in a city, who will fit himself by study to be at least conversant with the most successful methods. The mobilization of stiffened joints peculiarly concerns orthopedic surgeons, and the profession has a right to expect most careful consideration by them of a matter so important.

For the history of attempts at the mobilization of stiffened joints the reader is referred to excellent articles by Payr,[1] Baer,[2] Murphy,[3] Neff,[4] R. T. Taylor,[5] and others.

[1] Arch. f. klin. Chir., 1912, xcix, No. 3.
[2] Am. J. Orth. Surg., 1909, August, 1.
[3] J. Am. M. Ass., 1905, May 20 and 27.
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## OUTLINE AND RESULTS OF SIXTEEN ARTHROPLASTIC OPERATIONS

### HIPS

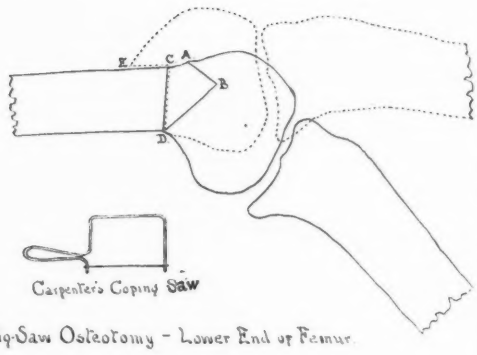
| Case No. | Age and Sex | Type of Ankylosis | Cause and Duration of Ankylosis | Date and Type of Operation | RESULTS | | |
|---|---|---|---|---|---|---|---|
| | | | | | Time since operation | Motion P.=Passive A.=Active | Stability and Function |
| 1 A. J. | 48 M. | Bony | Infectious arthritis 3 years | 1909. Excision. Flap of capsule. Trochanter in acetabulum. | 4 years | P.—30°–40° A.—Almost none | Poor. |
| 2 J. D. | 31 M. | Bony | Post-operative Old Nisser 1 year | 1911. Division bony bridge. Flap of tissue. Ant. incision. | 2 years | P.—90° A.—30°–40° | Fair. |
| 3 P. C. | 23 M. | Bony | Infectious arthritis 1 year | 1911. Lateral incision. Excision after fracture of neck. | | | Death, from shock and status. Lymphaticus. |
| 4 L. B. | 25 F. | Fibrous | Infectious arthritis 2 years | 1912. Ant. incision. Disarticulation. Reshaping of head. Free fascia flaps. | 12 months | P.—30° A.—20°–30° | Good. Dislocated after three months; reduced. No recurrence. |
| 5 P. D. | 57 M. | Fibrous | Hypertrophic arthritis 3 years | 1912. Ant. incision. Partial excision (Baer). | 4 months | P.—30° A.—20° | Fair and improving. |

### KNEES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 E. D. | 10 M. | Bony | Excision of knee 8 years Old poliomyelitis | Feb. 1, 1909. U-shaped incision. Reshaping ends. Baer's membrane. Sept. 2, 1909. Silk ligaments. | 3 years | P.—90° A.—None | Fair with splint. |
| 7 M. M. | 34 F. | Fibrous | Infectious arthritis 10 months | Sept. 1, 1909. Lateral incisions. Division of adhesions. Baer's membrane. May 2, 1910. Injection of oil. July 3, 1912. Post. incision. Spurs removed. | 4 years | P.—10°–15° A.—10°–15° | Good with splint. |
| 8 H. R. | 42 M. | Bony | Infectious arthritis 8 years | May, 1910. U-shaped incision. Bone ends shaped. Baer's membrane. | 3 years | P.—None A.—None | Good. Stiff. |
| 9 D. | 27 F. | Bony | Infectious arthritis (N) Few months | Sept. 1, 1911. Lateral incisions. Adhesions separated. | 1 year | P.—Few° A.—Few° | Fair. |
| | | | | Dec. 2, 1912. Lateral incisions. Free fascia beneath patella. | | P.—Few° A.—Few° | |
| 10 S. | 29 F. | Fibrous | Infectious arthritis 5 months | 1911. Lateral incisions. Adhesions separated. Free fascia flaps. | 1 year | P.—5°–10° A.—5°–10° | Fair with splint. |
| 11 B. | 30 M. | Fibrous | Infectious arthritis 1 year | 1911. Lateral incisions. Baer's membrane. | 1 year | P.—5° A.—None | Good. |

### ELBOWS AND JAW

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 C. H. | 23 M. | Bony | Old fracture 16 years | 1909. Post. incision. Gig saw shaping. Baer's membrane. | 4 years | P.—100° A.—90° | Fair—S. Good—F. |
| 13 W. C. | 40 M. | Bony | Hypertrophic arthritis 7 months | 1910. Post. incision. Gig saw shaping. Baer's membrane. | 1 year | P.—None A.—None | Good. Stiff. |
| 14 D. C. | 40 M. | Bony | Old injury? Tuberculosis? | 1911. Post incision. Gig saw shaping. Free fascia flaps. | 2 years | P.—20° A.—10° | Poor. |
| 15 L. W. | 22 F. | Bony | Infectious arthritis (N) 2 years | 1912. Post. incision. Shaping of bones. Free fascia flaps. | 6 months | P.—30° A.—25° | Fair. |
| 16 A. B. Jaw | 26 F. | Bony | Infectious arthritis 2 years | 1910. Excision of condyle. Baer's membrane. | 3 years | P. and A. 1½ in. separation | Good. |




Jig-Saw Osteotomy - Lower End of Femur.

The charts will outline quickly the scope of the operations. I have included two private cases of Dr. J. E. Goldthwait's in which the unsuccessful operation was performed by the writer at his request, two cases of Dr. E. G. Brackett's, and one case of Dr. C. F. Painter's, operated on by them. My thanks are extended to these three surgeons for their permission to report their cases. Detailed reports of the cases are not necessary in such a communication as this. The important points and the types may be gathered from the appended charts.

We have used to prevent ankylosis recurring, either chromicized pig's bladder as recommended by Baer or pieces of free fascia removed from the fascia lata at the time of operation. In two of the hip cases we have turned in pedunculated flaps of tissue. In only one case has any considerable inflammatory reaction followed the use of the pig's bladder membrane, but in every case there has been a slight discharging sinus, sometimes coming on as late as three weeks after the operation and often persisting for months. In three cases the membrane itself, in whole or in part, has been extruded several weeks after the operation; but that has not seemed to interfere with persisting mobility. In the cases where free fascia flaps have been used, the healing has been by first intention, and no sinuses have occurred except in the one case of a tuberculosis developing in the operated elbow six months after the arthroplastic operation. Although generous portions of fascia lata have been excised (four inches square) there has been no subsequent muscle hernia or any evident weakness.

We realize how inconclusive these unsuccessful results are. That the technique was faulty in many of the cases is at once apparent. We are aware at present of many details which might change the outcome. Yet I confess the end results of some of the cases have given me pause. When we obtain a joint with useful motion persisting for six months and then gradually see this motion disappear, in spite of careful after-treatment, owing to joint sensitiveness and to soft part contractures, and when we may watch the overgrowth of bone about our seat of operation continue for long periods, we owe it to our patients to explain these possible contingencies until we know how to surely prevent them. Payr has wisely said that we must carefully select our cases both in relation to occupation, social status, and temperament, before we attempt by the methods now advocated to mobilize stiffened joints, and the writer would add that in addition to this selection our prognoses should be most guarded as to painless or useful motion and as to function.

# CHOLECYSTECTOMY[1]

By JOHN B. DEAVER, M. D., Sc. D., LL. D., Philadelphia

WHEN we consider the great surgical importance of the gall-bladder, the extraordinary variability of its pathology, the severity and deadly nature of the diseases which affect it directly and through it indirectly involve the neighboring organs, the mortality which still clings to both medical and surgical treatment, and finally, the lack of accord among experienced surgeons concerning those procedures best suited for the treatment of certain most serious aspects of gall-bladder disease, it is evident that the subject of cholecystectomy is not one to be lightly considered or easily decided. We who practice surgery must act, whether we wish it or not, as judges in a capital case upon which not only one but many lives depend.

In certain well defined conditions there is practical unanimity concerning the advisability of removing the gall-bladder. These are:

1. Hydrops with obliteration of the cystic duct.
2. Chronic empyema.
3. Calcareous degeneration.
4. The cholesterin gall-bladder of Moynihan.
5. Gangrene.
6. Carcinoma limited to the gall-bladder.
7. Extensive laceration or perforation of the gall-bladder.

These conditions possess in common these two undesirable features: (1) the impossibility of *restutio ad integrum* and (2) the certainty or probability of a progress of the disease. There is but little chance for division of opinion in the presence of plain indications such as these. Yet a word of caution here is not unnecessary. The patient and surrounding conditions must be considered as well as the lesion. As Lilienthal has well said, "Anyone can learn to work according to set rules, but only an artist knows when to disregard them." I have, on more than one occasion, been content simply to drain a gangrenous gall-bladder and have seen the patients recover without the necessity for a second operation. These were cases, often desperately sick, in whom I found that the omentum had preceded me to the seat of the trouble and wrapping itself about the gangrenous area had effectually excluded it from the general abdominal cavity. To break up these protecting adhesions and inflict upon the acutely inflamed area the trauma necessary to the removal of the gall-bladder would be to invite catastrophe. Under these circumstances it is better to accept the chance of being obliged to do a second operation, for surely a living patient after two operations is better than a dead patient however beautifully and thoroughly operated.

With this provision we may accept as absolute indications for cholecystectomy the conditions already enumerated. But the majority of cases that come to operation today show no such advanced pathology. What is to be our attitude toward the lesser grades of acute and chronic cholecystitis with or without stones; toward the cystic gall-bladder when from the appearance and the condition found it is quite apparent that the occlusion of the cystic duct is of recent date; toward the cases of localized gangrene of the fundus of the gall-bladder; toward cases of small perforations or wounds; and finally, and of special importance, what shall we do in the presence of pancreatic involvement or peripancreatic retroperitoneal lymphangitis and lymphadenitis?

In such cases the question of cholecystostomy or cholecystectomy must be met and decided by the surgeon. The operation of cholecystotomy, which consists in simple incision of the gall-bladder, removal of the calculi, and closure without drainage is the classical operation for gall-bladder cholelithiasis and though formerly often performed with good results it has been almost discarded of late years owing to the appreciation of the need for drainage in clearing the gall-bladder

[1] Read before the Springfield Academy of Medicine, Springfield, Mass., April 8, 1913.

and biliary passages of the infection, of which the calculi themselves are but a result. Kocher has never quite abandoned cholecystotomy, and recently a few prominent surgeons have shown a tendency to employ the operation in selected cases. If the recent ideas of Aschoff and Bacmeister are correct as to the possibility of the pure cholesterin stone being formed in the gall-bladder as a result simply of stagnation and altered metabolism without the presence of infection, this simple operation would seem not only proper but preferable since the likelihood of post-operative adhesions would be much reduced. On the other hand such simple conditions come very rarely to operation. When the calculi are the result of catarrhal inflammation of the gall-bladder due to the presence of bacteria, drainage is decidedly indicated. It is true that infections of the gall-bladder die out in a percentage of cases and at the time of operation no organism can be obtained by culture in about fifty per cent of the cases. Yet there can be no doubt that in some instances organisms may be lurking in the crypts and folds of the mucosa of the gall-bladder when they are not demonstrated by cultures of the bile. Moreover, it is not usually possible to determine at the time of operation whether active infection is or is not present. Therefore I feel that the patient's welfare will be best guarded by the institution of drainage in all such cases, since this can do little if any harm, while the failure to drain may permit the infection to resume its activities unchecked. Granting, then, the applicability of simple cholecystotomy in cases properly selected, it is nevertheless true from a practical standpoint that the surgeon will very seldom be able to select such cases, and as a rule some operation involving either drainage or removal of the gall-bladder must be employed if we wish to do the greatest good to the greatest number.

To remove or not to remove the gall-bladder is the question that makes Hamlets of us all. The conservative section holds to cholecystostomy in all conditions other than those enumerated as the absolute indications for cholecystectomy. Those who take this stand do so because they believe that the function of the gall-bladder is a beneficial one and should be preserved whenever possible; that the effects of drainage are as truly curative as the more radical operation; that the lesser operation has a well defined lower mortality than the more radical; that post-operative complications and remote effects are less dangerous and troublesome after simple drainage than after removal, and that in the event of a later operation being required the presence of the gall-bladder and the absence of the dense adhesions which often follow cholecystectomy render the surgery of the biliary passages easier and less dangerous.

On the other hand, those who would extend the field of cholecystectomy argue that the gall-bladder is a vestigeal and unnecessary organ; that permanent cure is not assured by drainage; that reinfection occurs not infrequently requiring re-operation or re-establishing invalidism on the part of the patient; that, granting the truth of increased difficulty of a secondary operation after removal of the gall-bladder, the chance of such an operation being necessary is much diminished, and finally that the slightly increased primary mortality of cholecystectomy is more than compensated in the long run by improved results.

The precise function of the gall-bladder is, like that of the appendix, not definitely settled. The structure and apparent function of the appendix, however, suggests that its activities do not differ materially from that of the large intestine adjacent to it. For this reason the loss of its function to the body is of no moment. The gall-bladder, however, is a highly differentiated portion of the biliary tract and we cannot so reasonably expect complete compensation for its loss if we conceive of its function as being one of importance. The old idea of the physiologists that the gall-bladder served as a reservoir for bile during the period when it was not needed for digestion is quite inadequate considering the small size and moderate distensibility of the gall-bladder together with the fact that the average daily output of bile in the adult is from 30 to 50 ounces. Moreover, the muscular coats of the gall-bladder are not capable of expelling its contents completely, which further detracts from its value as a storage

organ. That the bile does back up in the gall-bladder during the intervals between digestion is certain, as is shown by the increased drainage from a cholecystostomy opening during the night. Nocturnal pain in cholecystitis may also be explained in this way, the gall-bladder being distended by the back-flow and in its inflamed condition giving rise to pain. The suggestion that it acts as a tension bulb has much to commend it. During the fluctuations in pressure within the ducts which probably occur as a normal consequence of digestion and the influences which increase or diminish the secretory activity of the liver cells, as well as those fluctuations in pressure which undoubtedly result from pathological causes, the existence of such a diverticulum from the duct tract undoubtedly spares the parenchyma of the liver from back pressure in many instances. Observations by surgeons of dilatation of the common bile duct after cholecystectomy would seem to support this view and it has even been observed that a diverticulum has formed from the cystic duct after the gall-bladder had been removed. The mucus found in the gall-bladder is believed also to have a beneficial effect in diluting the bile and rendering it less harmful in the event of its retrojection into the pancreatic duct. Whether or not our ideas concerning it be right, it seems to me that the evidence favors the belief that the gall-bladder has a desirable function, even though the fact that its presence is not necessary to good health cannot be gainsaid. We must remember, however, that its functions must be very materially altered by inflammation which thickens and contracts its walls and changes the character of its secretions.

Much hinges upon the curative value of cholecystostomy in gall-bladder infections. There can be no doubt that the complete rest thereby afforded to the gall-bladder walls as well as the drainage of the bile from the catarrhal passages does cause subsidence of the infection. It does not however restore, nor can it be expected to restore the organ to a normal condition. If any extensive inflammatory alterations have taken place, the scars must remain not only as mute evidence of the previous infection but as a point of diminished resistance in the future. Still it is surprising in how many cases permanent cure results. The reformation of gall-stones after cholecystostomy is a very rare occurrence. I have observed one instance in which I operated and removed 100 gall-stones. Two years later a second operation was done and 200 gall-stones removed. It is not very uncommon to leave stones behind, but I flatter myself that I could scarcely have overlooked this number. Yet this may have been an example of the cholesterin gall-bladder of Moynihan, also called the strawberry gall-bladder by MacCarty. In this condition which I had observed and mentioned prior to either of the above gentlemen, we find small gall-stones or particles of cholesterin embedded in the mucosa of the gall-bladder. These cannot be scraped out nor disposed of by drainage so that the presence of this condition is now recognized as a sufficient cause for cholecystectomy.

Mayo has observed five cases in which there was every reason to believe that stones had re-formed in the common duct. We must, therefore, admit the possibility of recurrence of gall-stones after operation, a chance the danger of which is greatly diminished by removal of the gall-bladder.

Pancreatic and peripancreatic inflammation when associated with gall-bladder disease should influence our treatment of the gall-bladder itself. We (Dr. D. B. Pfeiffer and myself) have in another paper pointed out the method by which infection is carried from an inflamed gall-bladder to the peripancreatic tissues and we believe that in a percentage of cases the pancreas may be secondarily infected in this manner. The lymphatics of the gall-bladder are collected into trunks which travel along the cystic duct to the right free border of the gastro-hepatic omentum following the course of the common duct. Some of these trunks are interrupted in their course by lymph nodes, one of which is found quite constantly at the neck of the gall-bladder, another at the junction of the supraduodenal with the retroduodenal portion of the common duct. Occasionally still others are met with. Some of the trunks are

not thus interrupted but pass together with the efferent lymphatics from the glands just mentioned to the cellular tissues and glands immediately in relation with the pancreas. As regional glands of the pancreas, Bartel describes the pancreatico-splenic and superior pancreatic, the superior gastric, hepatic, pancreatico-duodenal (anterior and posterior), mesenteric, mesocolic, inferior pancreatic and peri-aortic. These groups will be found pictured and described more fully in an article by Deaver and Pfeiffer.[1]

To all these groups of glands the pancreas sends lymphatic branches which may anastomose in the cellular retroperitoneal tissues with the lymphatics from the stomach, duodenum, spleen, liver, gall-bladder and bile ducts, the colon, and even the left suprarenal. Probably still other intercommunications exist which were not demonstrated. I have seen retroperitoneal lymphatic infection in this situation which was undoubtedly of appendicular origin. Only when the intercommunications of the pancreatic lymphatics with those of the adjacent organs are most intimate, short in their course and unprotected by intervening lymphatic nodes, does peril commonly arise of lymphangitis being communicated to the pancreas itself. This most intimate relation Bartel has shown to exist with the lymphatics of the adjacent duodenum, and more recently Franke has shown that the same is true of the lymphatics coming from the gall-bladder. The lymphatics arising from these sources are in many instances closely applied to the surface of the head of the pancreas and inosculate directly with the efferent lymphatics from that organ. The inflammation of the head of the pancreas which we see so commonly in gall-bladder inflammation corresponds in extent to the lymphatic distribution and not at all to the duct distribution as would naturally be the case were the infection the result of ascending duct infection.

For some time I have been observing these peripancreatic lymph nodes in the course of my upper abdominal explorations and I find them almost invariably enlarged in gall-bladder infections. This is a condition in every way comparable to enlargement of the cervical glands associated with tonsillitis. When the source of infection is removed the lymphatic damage also recovers. Absorption of bacterial toxins from the gall-bladder occurs chiefly in this way and the serious effects of this absorption are a well-known clinical fact. Babcock has pointed out the rôle of cholecystitis in the causation of myocardial degeneration, but the other organs suffer as well. Arterial, renal and other serious toxic effects may follow the same cause. When, in my opinion, such a condition is present and the gall-bladder presents such serious alterations as to make the question of cure by cholecystostomy problematical, I do not hesitate to perform cholecystectomy. This aspect of the question must be thoroughly understood. I am not advocating cholecystectomy in all cases of peripancreatic or pancreatic inflammations. Not all cases of pancreatitis arise in this manner. When the pancreas appears markedly or chiefly affected I would hesitate to remove the gall-bladder because of the possibility that it may be needed at a later period owing to the progression of the pancreatic lesion and obstruction of the common duct thereby. In the event of such a complication the safest and best operation would be cholecystoduodenostomy, the condition of the gall-bladder warranting. The operations devised for transplantation or reconstruction of the common duct are ingenious and may serve in desperate straits, but I would not willingly put myself in the position of being obliged to rely upon them.

The higher mortality of cholecystectomy as opposed to cholecystostomy is one of the strongest objections to the extension of cholecystectomy into fields where it is not positively required. Yet we should not be misled by the published figures of the relative mortality of these two operations. Most surgeons admit from two to five times as high a mortality in removal of the gall-bladder as in drainage. It must be remembered, however, that cholecystectomy has been reserved by most surgeons for the more severe and complicated cases in which the mortality is necessarily high from the severity of the disease itself, entirely apart from the type of

[1] Am. J. Med. Sc., April, 1912.

operation performed. We can get a clearer idea of the relative dangers from Kehr, who advocates and performs cholecystectomy more freely than other surgeons of prominence in this field. He reports a mortality of 1.5 per cent in cholecystostomy and 3.7 per cent in cholecystectomy. Even here, however, the cholecystostomies were as a group less seriously diseased. It is thus seen that the discrepancy is not so forbidding and warrants us in fitting the operation to the case when we are convinced that removal of the gall-bladder is the operation of choice. Still, cholecystectomy will remain an operation of slightly higher mortality, as is inevitable from the more extensive trauma and greater time required for its performance.

The adherents of cholecystostomy make capital of the fact that the gall-bladder is a most valuable guide in the event of secondary operation being required. It is the thread of Ariadne which guides the surgeon through the maze of adhesions to the common duct. The gall-bladder and cystic duct in this respect bear the same relation to the common duct as the cæcum and the anterior longitudinal muscular band of the cæcum bear to the appendix. The adhesions subsequent to the primary operation are likely to be less dense and baffling after cholecystostomy than cholecystectomy.

To this the advocates of cholecystectomy reply that secondary operations will seldom be needed after the gall-bladder is removed. Persistent fistulas are rare. The hive of infection is removed from further possibility of trouble, and in case re-operation is necessary, the obstacles are by no means insuperable.

My own experience with these operations, their relative mortality and curative effects, inclines me to be rather more radical than hitherto. I would still counsel the inexperienced surgeon to cling to cholecystostomy. Its results are often truly surprising in most complicated conditions. I have, however, had enough disappointments with cholecystostomy to believe that there are cases in which I should remove the gall-bladder providing only that I am able to select them at the time of operation. The class of cases in which at the present time I am inclined to favor cholecystectomy over cholecystostomy are those who give a long history of recurrent febrile attacks with more or less permanent gall-bladder changes and showing evidence of peripancreatic lymphangitis often with some communicated inflammation of the head of the organ itself.

In most cases of acute calculous cholecystitis I remove the gall-bladder. When localized gangrene is present I believe it should be removed except in the ultra severe types of infection already isolated by old or fresh adhesions, as I have previously indicated. I do not remove gall-bladders simply for old chronic changes unless the organ is practically destroyed and valueless or dangerous in appearance from the standpoint of malignancy.

In other words, gall-bladders which we know from the symptoms and appearance to have become the seat of chronic infection with periodical exacerbations will in the majority of cases be best treated by cholecystectomy.

The age and resistance of the patient, so far as we are able to estimate it, should be taken into account in our decision and we should not insist upon cholecystectomy in enfeebled patients who may by drainage survive and gain in strength to such a degree that removal can be done later if symptoms recur. Temporary improvement is the rule after cholecystostomy. Permanent cure results in the majority of cases, but in the chronic infection carriers cholecystectomy is more reliable from the standpoint of the ultimate result.

In other words, I am inclined to give the findings of bacteriology more weight in deciding upon the type of gall-bladders which should be removed. A gall-bladder thoroughly and chronically infected which has evidence of chronic systemic intoxication and regional involvement of adjacent organs, notably the pancreas and peripancreatic retroperitoneal tissues, I believe is too dangerous a source of future trouble to rely upon cholecystostomy for permanent cure, and this is particularly true if drainage of the bile is not continued for a long period, provided simple cholecystostomy is performed. While cholecystectomy is, I believe, the operation

of choice in this class of cases, for good and sufficient collateral reasons one will often content himself with cholecystostomy. In this case a large tube should be employed and not removed before two weeks have elapsed in order to create a firm sinus that will not close in less than six or eight weeks. By long continued drainage there is the greater chance of ridding the organ completely of its lurking infection, and in our decision as to the operation to be employed we should ever bear in mind that the most serious question is that of infection and liability of re-infection. The biliary tract without a gall-bladder, particularly a damaged gall-bladder, is much less likely to become the seat of future micro-organismal invasions.

The removal of the gall-bladder may be a matter of extreme simplicity or of the greatest difficulty according to the situation and degree of involvement by adhesions and inflammation. As a rule, the stronger the indications for cholecystectomy the greater the operative difficulty.

While a liberal incision is required for this work, I have never found it necessary to employ the post-mortem incisions advocated by some surgeons. Neither do I use such incisions as that of Kehr which, in addition to the vertical right rectus incision, has an arm at right angles from the lower end of the vertical arm, transecting the rectus muscle and semilunar line and splitting the flat muscles of the abdomen. Ample room can be secured by a slightly curved incision beginning just below the ensiform cartilage, following, with a slightly upward and outward convexity, the costal margin, then carried straight down between the fibers of the upper rectus as far as is required. With the relaxation of the abdominal walls, such as can be secured by ether (but not with gas and oxygen), the operative field is clearly exposed. In some cases I dislocate the liver downwards and upwards, bringing it partly out of the incision, after the manner of Mayo Robson. This is accomplished by seizing the margins with gauze, taking care not to crush the friable parenchyma. If this can be accomplished it brings the cystic and common ducts nearer the surface. In all cases I place a sand bag under the lower thoracic spine for the same purpose.

It is important first to clear the adhesions from the gall-bladder. When these are omental it is a simple matter, but when firm union has taken place with the duodenum or other hollow viscus there is considerable danger of opening the bowel and contaminating the field. To obviate this the dissection should be made cautiously, keeping close to the gall-bladder rather than to the bowel. In the case of fistulous communication between the gall-bladder and the bowel it will be necessary to open the tract and this should be done with as little soiling and as much protection of the adjacent areas as possible. Having freed the gall-bladder and cystic duct a clamp may be placed upon the duct, and the cystic artery. Then, catching the duct again just distally to the first clamp, the duct is cut between the two and the organ dissected from its fibrous bed from below upwards, leaving if possible, a portion of the fibrous bed rather than dissecting it from the liver tissue, which is more likely to leave a lacerated surface with oozing that is difficult to control, especially when jaundice is present. As the late Maurice Richardson has pointed out, it is necessary to use care in tying off the cystic duct not to pull up the common and hepatic ducts at their point of junction with the cystic which may lead to their being included in the ligature, an error which leaves the last state of the patient worse than the first. Indeed, in all this work it is necessary to be thoroughly familiar with the normal anatomy and the variations which may occur, whether of congenital or pathological origin.

It is usually possible to oversew the fossa of the gall-bladder and obliterate it at once.

However well I may tie off the cystic duct and obliterate the fossa of the gall-bladder, I never close the abdomen without drainage, fearing that the back pressure of the bile may force the ligature. We learn much from our disagreeable experiences.

Several years ago I performed a cholecystectomy with ligation of the cystic duct and complete closure of the abdominal wall. The *vis a tergo* of the bile forced the ligature on the cystic duct and a considerable amount of

bile escaped into the abdominal cavity. Fortunately, it became walled off in the kidney well, and in a few days found its way out through the wound. This lucky result did not occur without much distress on the part of the patient and much worry on the part of the surgeon. Since that time I have never neglected to carry a small rubber tube down to the stump of the cystic duct and have not had this complication occur. Often the question of hepatic drainage must be met. Naturally, if any obstruction exists within the common duct it will be necessary to open the duct, and after dealing with the obstruction, drainage must be instituted. Even when no definite obstruction exists, but evidence of diffuse catarrhal cholangitis is at hand, biliary drainage should be provided. At times this may be done by a rubber tube passed down the cystic into the common duct. If this is not possible the common duct should be opened directly and a rubber tube sutured in place. A curious anomaly which I have observed many times is a low implantation of the cystic duct into the common duct so that the lower part of the cystic duct may occupy the outermost portion of the free border of the gastro-hepatic omentum and be incised by the surgeon in the belief that it is the common duct. When this is the case it is necessary to direct the drainage tube downwards toward the common duct rather than upwards toward the liver as one would naturally do in placing a tube in the common duct to drain the bile as it comes down from the liver. If a T-tube is employed it makes no difference. Common duct drainage should be provided whenever the pancreas or peripancreatic tissues show evidence of recent infection. To what extent common duct drainage is successful in draining the pancreas also is a question yet to be settled. Naturally, such drainage could not occur in the cases in which the pancreatic duct fails to communicate with the common duct, either directly or through the medium of the sinus of Vater. In one case during the past year I saw indisputable evidence of the drainage of pancreatic juice through the common duct. The attention of my assistant, Dr. Pfeiffer, was drawn to this by the excoriation of the skin about the wound where the drainage from the duct tube had escaped. Testing the biliary discharge for the presence of the pancreatic ferments, trypsin, steapsin and amylopsin were demonstrated. In certain other cases we failed to find these ferments. Even when the duct is not drained directly there seems to be no reason to doubt that biliary drainage is beneficial to the pancreas by allaying the cholangitis, which is unquestionably a factor in the production of pancreatic inflammation.

If there has been marked acute pericholecystic inflammation, or if soiling of the field has been unavoidable during the manipulations, I frequently place a glass tube down to the renal fossa in the subhepatic space, which is allowed to remain for twenty-four to thirty-six hours.

The wound is sutured in layers and the drainage allowed to emerge through one portion of it, or through a separate stab if that is the most direct route to the surface. I am fond of draining through a separate stab, as that allows better closure of the long wound. Naturally, when there is much drainage a stab is not advisable.

It is my practice to elevate the foot of the bed about six inches after an operation of this character, believing that it is more rational to confine exudate and infection to the area of drainage than to try to gravitate them to the pelvis through uninfected peritoneum; this position is maintained, however, only for 24 hours, when the patient sits up in bed. The latter position lessens the chances of an embolic pneumonia. The after-treatment is that usually employed in abdominal cases.

# DRAINAGE OF THE UPPER INTESTINAL LOOP FOR THE RELIEF OF ILEUS; BASED UPON EIGHT CLINICAL CASES SUCCESSFULLY OPERATED, AND ANIMAL EXPERIMENTATION

By C. HUGH McKENNA, M. D., Chicago
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CLINICAL observation over a large number of cases of acute bowel obstruction, with its immediate and high mortality, suggested to me making an investigation of the fatal factor in ileus.

On analyzing the cause of death from acute bowel obstruction, it would seem that one of the three following factors must be made responsible for the fatal termination; bacteriological, nervous, or toxic.

1. The bacteriological factor may be eliminated since, (*a*) death comes too early, and (*b*) bacteræmia only rarely occurs.

2. From the standpoint of a primarily disturbed innervation, statistics, and our own observations in operative measures on the upper intestinal tract and stomach, seldom show any disturbance of this nature.

3. The toxic element, I believe in view of our clinical experience and animal experimentation, and that of co-workers on this same subject, fully explains the cause of death in acute bowel obstruction.

I am of the opinion that when the physiological balance of the normal intra-enteric secretion (the secretion from the duodenal mucosa, probably from Bruner's glands) is disturbed the secretion becomes profoundly toxic and unless this physiological balance is quickly restored, a fatal termination surely and swiftly ensues. In other words, any influence that leads to an upper intestinal paresis sufficient to stop peristalsis, blocks the normal flow of the duodenal secretion as effectively from the point of view of ileus, as if the gut were mechanically closed. I am of the opinion that the duodenal stasis produced by paresis of this portion of the gut may be compared to the duodenal stasis produced in the dog by closing the lower end of the duodenum. The blocking up of the duodenal secretion may become a fatal factor in one of two ways: First, by direct absorption into the blood as a powerfully toxic substance; second, because of the improper mixture between the secretion of the duodenum and the secretion from the lower intestinal tract.

In the light of our clinical and experimental work, and the work of other investigators — particularly Whipple and Bernheim,[1] it would seem as though we were justified in claiming that the fatal factor in ileus is a poisonous element derived from the duodenal mucosal secretion, the toxicity of which is brought about because of a disturbed interchange of secretions between the upper and lower parts of the small intestine. We are of the opinion that this toxic secretion is absorbed directly through the non-resisting paretic duodenal wall.

The point that is of especial interest to us in this connection as clinical surgeons is the beneficial rôle drainage of the intestine plays, in reducing mortality, in cases of acute bowel obstruction. We have up to the present successfully operated eight cases of acute bowel obstruction, by enterestomy. In the early cases it was more chance than any other factor that lead us to make an enterostomy high in the small intestine. At any rate, the opening was made high enough so that by means of long catheters introduced into the bowel, pancreatic secretion was poured out upon the abdominal wall. The presence of pancreatic secretion was first detected because of the very marked excoriation produced on the skin. In these cases, and in subsequent cases, we were sure we noted a relationship between the welfare of our patients and the presence of pancreatic secretion at the intestinal opening.

The presence of pancreatic secretion at the site of the enterostomy proved the presence of duodenal secretion. Investigation naturally turned toward experimentally determining: First, whether liberation of the duodenal secretion causes the welfare of the patient and

[1] Bull. Johns Hopkins Hosp.

if so, what in the secretion is responsible for the relief.

During my early experimental work four years ago on this subject, J. Draper Maury, of New York, published a paper along this line and from his paper I have borrowed my classification of duodenal secretions.

Duodenal secretions:

I. Extra-enteric.
   (*a*) Bile.
   (*b*) Pancreatic.

II. Intra-enteric.
   (*a*) Secretion from the glands of Bruner.
   (*b*) Secretion from the remaining duodenal mucosa.

Experimental work with dogs:

A. Experiments on intestines, ducts not disturbed.

1. Lower portion of duodenum closed with a ligature, animal dies usually in about 36 to 48 hours.

2. Lower part of ileum closed with ligature — gut is cut off by the silk and intestine re-establishes itself so that reocvery takes place.

B. Experiments on the bile and pancreatic ducts, with cholecystotomy.

1. Extra-enteric secretion shut off from the intestine by applying ligatures to the common bile duct and the greater and lesser pancreatic ducts. Ligature found to close these ducts only temporarily and patency re-established.

2. Extra-enteric secretions blocked from the duodenum by double ligatures dividing the ducts between the ligatures. This procedure effectively prevents the re-establishment of either the bile or pancreatic ducts.

C. Secondary operations on the intestines of the dogs in which extra-enteric secretions were blocked from the duodenum, with cholecystotomy.

1. Second operation three weeks following first. Ligature applied to the lower portion of the duodenum. Dog lives. Intestine re-establishes itself.

2. Second operation three weeks following first, lower portion of duodenum closed by resection. Dog dies.

Dr. H. R. Kenney's report on low obstructions from the experimental laboratory of St. Joseph's Hospital.

Dog No. I. January 3d. Operated 9 A. M. Bowel ileum picked up doubly ligated and divided. Proximal and distal ends sutured to peritoneum wound closed in usual manner. Enterostomy performed. Jejunum opened at 8 P. M. Peristaltic action of bowel markedly increased; no other microscopic findings.

January 4th. Dog in good condition, walking about and drinking water freely; enterostomy opening draining.

January 5th. Dog's condition unchanged.

January 6th. Dog's condition unchanged.

January 7th. Dog's condition unchanged. Wound where occlusion performed open and intestine draining there also.

January 8th. Dog killed with chloroform and post-mortem performed. No peritonitis present. Adhesions round site of occlusion. The occluding ligature round proximal end of intestine had cut through all the coats of intestine and allowed contents to escape through wound.

Dog No. II. January 9th. Operated 5 P. M. Clamp applied to ileum four inches above ileocæcal valve. Abdomen closed in usual manner.

January 10th. Dog able to walk about and drink water.

January 11th. Dog seems better than on previous day.

Jejunostomy performed at 7 P. M., 50 hours subsequent to occlusion. Abdomen opened, left side and small intestines found dilated; no peristaltic movements noticed. Dog died from overdose of anæsthetic and operation discontinued.

Post-mortem. Clamp site found completely shut off by adhesions and tight. (Specimen saved.)

Dog No. III. Operation January 11th, 7 P. M. Clamp applied as in previous case.

January 12th. Dog walking about, drinking water.

January 13th. Dog vomiting, very stiff in hinder extremities. Dog died 3 P. M., 46 hours after application of clamp. Post-mortem. Acute peritonitis cause of death. Infection during operation. Clamp found imbedded in adhesions midway between pylorus and ileocæcal valve.

Dog No. IV. January 15th. Operation 8 P. M. Clamp applied near ileocæcal valve.

January 16th. Dog sick; vomiting.

January 17th. Dog walking about; better.

January 18th. Dog running about, drinking water.

January 19th. Dog stiff and vomiting. Enterostomy performed high up at 9 P. M. One hundred and nine hours after application of clamp. Gut found enormously distended, dark red color, etc.

January 20th. Dog very sick but able to stand up. Abdomen covered with discharge and skin red as if scalded.

January 21st. Dog very sick, unable to stand up; moaning; chloroformed at 10 P. M. Post-mortem: No peritonitis. The enterostomy opening at the duodenojejunal junction. Mucous membrane proximal to opening red and inflamed. Gut below enterostomy wound normal until a point about two inches above site of occlusion, where a perforation had occurred. The site of the perforation was walled off from general peritoneal cavity by adhesions.

Dog No. V. January 27th. Ileum picked up. Ligatured in two places. Divided ends inverted 9 P. M.

January 28th. Dog well, up and about, drinking water.

January 29th. Dog well, up and about, drinking water.

January 30th. Dog well, up and about, drinking water.

January 31st. Dog well, up and about, drinking water.

February 1st. Dog well, up and about, drinking water.

February 2d. Dog died at noon, 156 hours since occlusion performed.

Post-mortem: Ileus. Gangrene of gut. Perforation peritonitis.

Dog No. VI. Occlusion as in No. V. Dog lived 123 hours. Post-mortem findings identical with No. V. No enterostomy performed in these two cases.

In all the dogs bowel below obstruction site was loaded with contents. Dog in which occlusion site was high (in the jejunum as No. III) showed severest symptoms. This corresponds to what we know to be fact clinically, that high obstruction in man is more rapidly fatal than low obstruction.

In every case the dogs seemed sickest on day following operation and seemed to vomit most.

The peristaltic action is completely arrested in the distal portion of the bowel, as soon as occlusion is performed and contents are retained. The lumen of the bowel is narrowed and filled with mucus and contents.

Peristaltic action *above* obstruction is at first exaggerated; this increased activity seems to have for its object removal of obstruction (which causes it), not the propulsion of bowel contents which do not seem to collect to any great extent above the obstruction. Fermentation of bowel contents causes formation of gas in intestine, and increases the intra-intestinal tension. The mucous membrane is damaged owing to diminished blood supply.

When and from what point antiperistaltic waves start, which have for their object the emptying of the intestine of its contents, has not been determined; but when an enterostomy is performed it is obvious that antiperistalsis in efferent loop will continue if the obstruction lower down is its starting place, and if the bowel is not yet paralyzed. Normal peristaltic waves will recommence in and empty efferent end.

Whipple of Johns Hopkins showed that if 12–15 cm. of the duodenum was isolated by closing either end, and the intestinal current established around this loop, the dog dies. I have performed only one such experiment and in that case the dog had a fatal termination in 36 hours.

Since the publication of Whipple and Bernheim's last communication, they have succeeded in chemically removing the mucosa from the isolated loop of duodenum above referred to, and in these experiments the dog lived.

These last experiments would seem to establish a logical reason for delivering the duodenum of its contents in conditions of acute stasis.

Can the duodenal secretions be drained off per orem by means of the stomach or duodenal tube? I believe not.

(*a*) Clinical experience in these cases with duodenal lavage has not given good results.

(*b*) Anatomically it would be difficult to remove all secretions from the duodenum, and particularly so in cases of acute paresis of this portion of the intestinal tract.

(*c*) Drainage of the duodenum must be permanent until the paresis of the bowel has completely subsided.

Permanency of drainage of the duodenum can most effectively be established by an enterostomy, preferably high up in the jejunum. However, I am of the opinion that if the operation be performed early enough, enterostomy in any part of the small intestine may give relief.

The operation, of enterostomy which is always performed under local anæsthesia, is made well above and to the left of the umbilicus as this location gives entrance to the abdominal cavity at a point where the upper portion of the jejunum can be picked

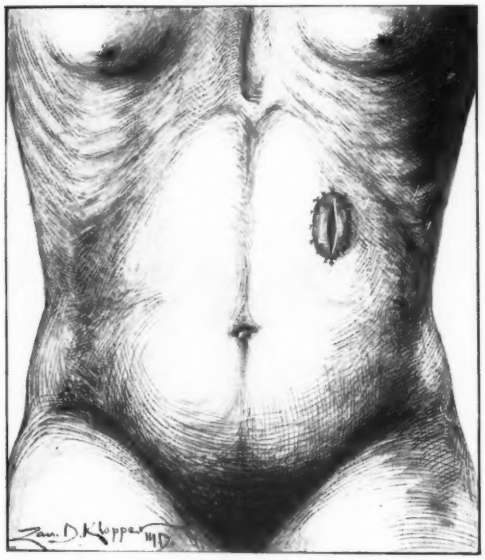

Fig. 1. Anatomical position for a jejunostomy in the upper portion of the jejunum.

up most accurately. We always pick up the first loop of small intestine that presents itself at the site of the opening, which I believe in a large percentage of cases will give a loop of small intestine well up in the jejunum.

Through the courtesy of Dr. Wm. R. Cubbins, in his course in operative surgery at the Northwestern University Medical School,

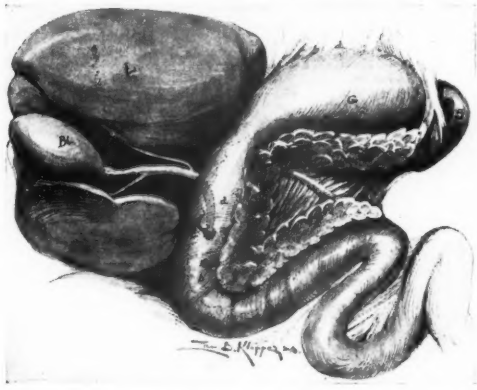

Chart 1. The upper abdominal viscera of the dog. A, duodenum; B, large pancreatic duct; C, small pancreatic duct; Bl, gall-bladder.

Fig. 2. Incision used in closing enterostomy.

I experimented on a dozen or more cadavers picking up the first loop of small intestine that presented in an incision at the left border of the left rectus muscle well above the umbilicus. In practically every instance the jejunum was picked up in the first four or eighteen inches of its beginning.

I cannot urge too strongly the necessity of preventing trauma and shock to the abdomi-

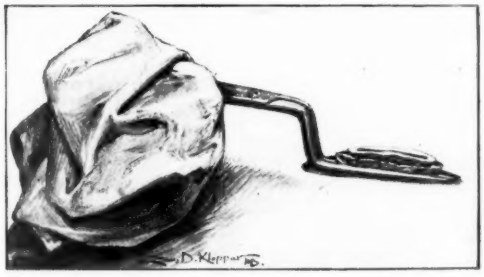

Fig. 3. Curved forceps is clamped around the stoma and the parietal peritoneum.

Fig. 4. Illustrating the plan of burning off the external infected portion of the intestinal opening.

Fig. 5. Clamps applied to the bowel preparatory to applying the shoemakers stitch.

nal viscera by non-interference with any but the very small loop of distended intestine in which you wish to establish enterostomy. For this reason I have always maintained that consultation should be arranged in all cases, so that a definite plan of action may be laid down which will enable the surgeon to understand precisely what he intends to do before the operation. I have seen failures of this operation, and have had others reported to me, in which an abdomen was opened in an acute ileus where the operator, after traumatizing large portions of the viscera and finding no organic obstruction, performed enterostomy. It is needless for me to tell you that with a patient in the extreme degree of shock in which we find them in acute ileus, this extra amount of manipulation of the abdominal viscera is enough *per se* to produce death. With a view to lessening the amount of trauma to the viscera and shortening the time required to perform enterostomy, I have turned to the possibility of arranging some mechanical device for this purpose. In this connection I wish to state that Dr. Wm. C. Lusk, of New York, has recently described such a device for this purpose. I have not had an opportunity to use this instrument, but the principle, according to description, appears to be correct.

Considerable stress should be placed upon the technique of this operation for I am of the opinion that the life of the patient depends upon the technical precision accompanying this procedure. Whether this operation be performed by the suture method or by a mechanical device, two principles must obtain to insure success: accurate and immediate approximation of the serous covering of the bowel to the cut edge of the skin and drainage of the upper loop of intestines, at least, by means of a tube.

A loop of intestine is emptied of its contents and held in the wound with a curved pair of rubber mounted forceps. A small portion of the intervening portion of bowel is attached to the cut edge of the skin by means of closely applied Lembert sutures. These sutures, which are of linen, must approximate the bowel to the cut edge of the skin, as before stated, and the upper and lower angles of the wound so closely that for the first six hours following the enterostomy there can be no leakage back into the peritoneal cavity. In other words, these stitches must cofferdam the peritoneal cavity from the infection of the intestine until a plastic exudate is thrown out around the bowel.

We still continue to introduce normal salt

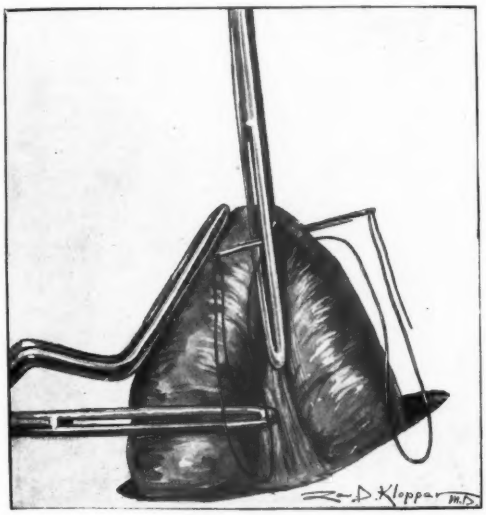

Fig. 6. Applying the shoemaker's stitch.

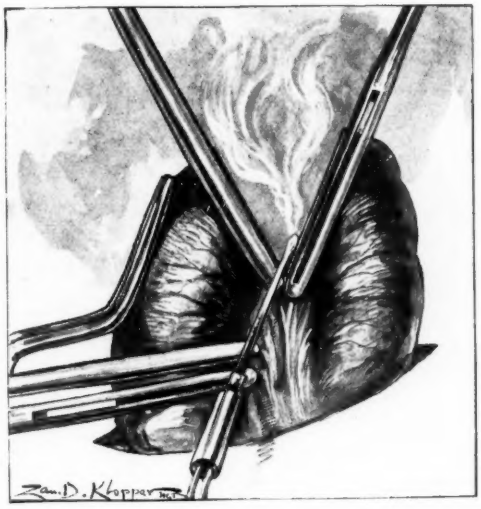

Fig. 7. Resection by means of the electrocautery.

solution into the intestine by means of long catheters, introduced into the intestine through the enterostomy. One catheter is placed in the oral loop of intestine, the other in the aboral loop. The salt solution is allowed to run in at frequent intervals, but in small quantities. Several hours are necessary before any appreciable amount of distention is relieved.

The salt solution performs a dual rôle: First, in mechanically washing out the blocked-up secretion and gas from the duodenum; and second, on account of rapid absorption from the intestine, becomes a powerful stimulant.

Under ordinary circumstances the enterostomy may be closed in about two weeks. The time of this operation, however, must be determined by the condition of the patient.

We have adopted the following plan in closing the intestinal fistula, which is demonstrated in the accompanying charts.

With the patient on the operating table anæsthetized, and a preliminary preparation of the abdomen made, an eliptical incision is made around the opening down to the peritoneum, using great care not to open this membrane. A curved intestinal forceps is now applied to the enterostomy stoma, grasping down well to the peritoneum with the forceps so that the infected portion of the gut distal to the bite of the forceps may be burned off with the cautery. After this procedure the abdomen is cleaned and asepticized without recontamination. The operation can now proceed as a clean abdominal section.

A resection of the fistula with a lateral anastomosis of the intestines is made.

We use the following technique in closing the end of the intestine, which has the advantage of (*a*) asepsis, (*b*) hæmorrhage, (*c*) time-saving, (*d*) surgical precision. A grooved intestinal clamp is placed on the intestine and a mattress stitch applied in the groove of the forceps, with a linen stitch threaded with a needle on either end — just as a harness maker sews a harness trace — another intestinal clamp is placed on the intestine parallel to the first, leaving just enough space to burn the intestine off with a thin-bladed cautery. The mattress type of stitch gives a thin edge that is easily invaginated with a Lembert suture. I believe this type of stitch is preferable to the circular ligature applied to the intestine, similar to the appendix ligature, and used by many surgeons in doing an intestinal resection.

The lateral anastomosis is made in the ordinary way with intestinal clamps and the Czerny and Lembert suture.

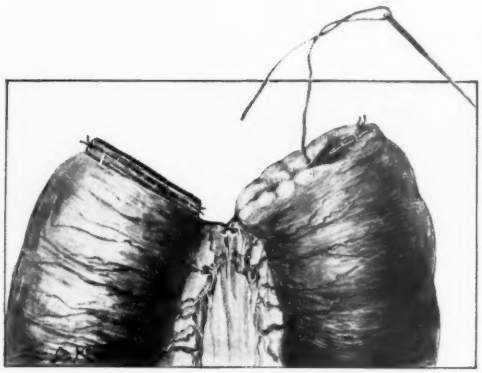

Fig. 8. Applying Lembert suture over the end of the bowel.

I have attempted to group the symptoms of ileus as they have appeared to me in the observations that I have made in my own experience. They are as follows:

(*a*) Marked abdominal pain.
(*b*) Abdominal distention.
(*c*) Weak, thready and rapid pulse.

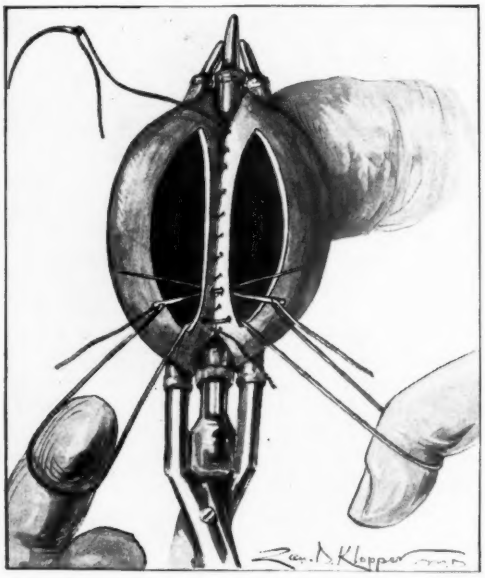

Fig. 9. Shows the type of stitch used in the lateral anastomosis.

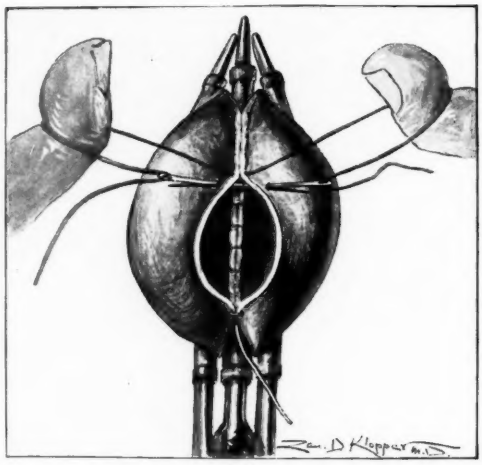

Fig. 10. Same stitch as Fig. 9. carried to the anterior portion of the anastomosis.

(*d*) Hypocratic face.
(*e*) Fæcal vomiting.
(*f*) Early in the disease, visible peristalsis.
(*g*) Regional distention (in some cases).
(*h*) Signs of peritonitis.
(*i*) Relief from the pain of onset.
(*j*) Alteration of kidney function.
(*k*) Marked leucocytosis.
(*l*) Marked lowering of blood pressure.

With the amount of literature coming in from various centers, and particularly with the favorable results where operation is not delayed, it would seem that operative intervention in acute bowel obstruction should be instituted earlier than is generally the plan at present.

From our own experience, we are firmly convinced that operation should not be delayed in these cases.

## CONCLUSIONS

Disturbance of innervation to the upper intestinal tract in the human sufficient to stop peristalsis, produces the same symptoms as mechanically blocking the same amount of intestine in the dog.

High intestinal stasis, whether paralytic or mechanical, is much more serious than low obstruction. The fatal factor in acute ob-

struction may be found in the secretions from the duodenal mucosa.

That the fatal factor in general peritonitis may be due to a duodenal secretion and not to the effect of infection *per se*.

That when the condition of acute ileus is definitely established, the duodenum should be drained early.

Lastly, that the duodenum can best be drained by performing a jejunostomy.

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# PRELIMINARY REPORT ON EXPERIMENTAL BONE AND PERIOSTEAL TRANSPLANTATION[1]

By W. L. BROWN, M. D., and C. P. BROWN, M. D., El Paso, Texas

FIRST: WILL PERIOSTEUM PRODUCE BONE WHEN TRANSPLANTED INTO TISSUES WITHOUT BONY CONTACT?

Experiment 1. January 8, 1913, white and tan fox terrier, age unknown. All of periosteum taken from the right femur, divided into four pieces, one piece planted into each shoulder subcutaneously and one into each loin, into the muscle after opening the sheath. Sheath was closed with oo plain gut; skin with oo chromic; incision over the femur closed with horsehair; muscles sewed over femur with oo plain gut. Primary union.

Sacrificed by chloroform in 30 days. Wounds were healed with very little scar tissue. No thickening could be felt through the skin over areas of transplant. Upon most careful examination no trace could be found of the transplanted periosteum, except a small scar in the right loin, adhered to the under side of the muscle sheath the size of a grain of wheat, with no evidence of bone formation.

Experiment 2. January 8, 1913, small black and tan dog, weight 10 pounds, age unknown. All of periosteum taken from the right femur, divided into four pieces, one piece planted into each shoulder subcutaneously and one into each loin inside the muscle sheath; the sheath closed with oo plain gut; muscle with oo plain gut; skin oo chromic. Primary union.

Sacrificed 30 days later; wounds healed without visible scar; no thickening to be felt from the outside except small movable hard body apparently the size of a large grain of wheat attached to the under surface of the fascia in the left loin. Upon making most careful examination, no traces of transplants could be found except the small scar as above stated, which microscopically showed no bone cells. In these eight free periosteal transplants there was no evidence of bone production found, and the transplants themselves were absorbed at the end of 30 days, the two small nodules recovered only being scar tissue.

SECOND: WILL PERIOSTEUM PRODUCE BONE WHEN LEFT ATTACHED TO BONE AND PERIOSTEUM AT PROXIMAL END, PASSED AROUND FASCICULI OF MUSCLE AND AGAIN CONTACTED WITH PERIOSTEUM?

Experiment 3. March 19, 1913, white and black mongrel, weight 28 pounds; both femurs bared and strip of periosteum 5/8 inch wide and 1½ inches long raised from each femur, pulled through slit in muscle, and again attached to periosteum, right side twisted on pedicle half around, left not twisted. Brought back and attached to periosteum; right side, muscle not sutured; left side, sutured with oo plain gut; skin closed with horse-hair. Dog was muzzled tightly with wire muzzle, but had the sutures out at the end of 36 hours, wounds gaping. Killed 5 days later following extensive infection. No post-mortem.

Experiment 4. March 24, 1913, brown spotted mongrel, young; both femurs bared, and strip of periosteum raised one inch long and one half inch

[1] Read before the Texas State Medical Association, San Antonio, May, 1913.

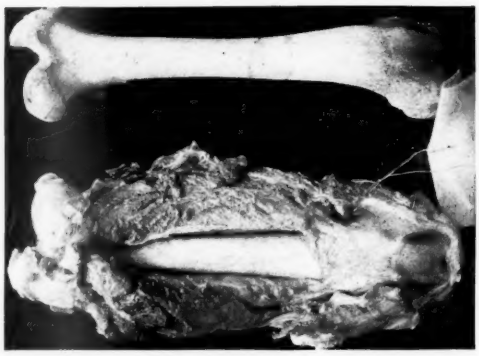
Exp. 9. Showing remains of spine of scapula; recovered forty-seven days after transplant inside of muscle sheath in loin, covered with periosteum. Notice thin, sharp edges and dimensions compared with area from which it was removed.

wide, passing through muscle back to the bone and sutured to the periosteum; left attached at proximal end. Muscle wound closed with oo plain gut, skin with horse-hair. Primary union.

Sacrificed May 3, 1913. No traces of the periosteum found in the muscle tissue, but at the point of re-contacting with the femur there was a bony spur ¼ inch long extending out into the muscle. This growth, as can be seen, comes from the bone; it is much larger at its base in contact with the shaft and comes to a point, where it projects into the muscles. It is evidently due to scraping of the bone at this particular point in raising the periosteum because of being in line of the muscular attachment to the femur, the periosteum here being much more adherent and much more difficult to raise. No evidence of bone having been reproduced by raised flap.

Left femur shows no evidence of bony reproduction in raised periosteal flap except at its tip, where it was re-contacted with the bone, and here apparently in the end of the periosteal flap is a little bony nodule ⅛ inch in diameter. It seems to have no attachment to the shaft, though there is a bony outgrowth from the shaft beneath it. This bony growth on the shaft is in the line of muscular and fascial attachments to the femur, and also represents an outpouring of osteoblasts from the trauma in raising the periosteum. Considering the fact that there is no bone in this flap of periosteum anywhere else except at the tip, this corresponding to the outgrowth beneath, leads one to the conclusion that the osteoblasts raised from the shaft were left in the end of the periosteal flap.

Experiment 5. March 20, 1913; small spotted mongrel, old; both femurs bared and strip of periosteum two inches long, ⅝ inch wide, raised, left



Exp. 11. Showing effects thirty days later of removal of periosteum from femur. New fibrous membrane, somewhat more adherent than normal periosteum; slight roughening of bone, and slight change of color; otherwise no evidence of change. Bones perform their functions as well as before. Other femur control specimen.

attached at proximal end, passed through muscle back to bone, reattached to periosteum; wound sutured with oo plain gut; skin with horse hair; the periosteal strip kept from rolling as far as possible; skin closed with horse-hair. Primary union.

Sacrificed May 3, 1913. In the right femur the periosteal flap had completely disappeared. No change in the shaft in any way. No reproduction of bone. In the left femur the periosteal flap had completely disappeared, except a very small fragment sticking into the muscle tissue where reattachment was made to the femur. No production of new bone.

Experiment 18. Young hound, black and tan, weight 15 pounds; right femur exposed; periosteum turned up from below, divided into two strips and

Exp. 13. Showing remains of spine of scapula wired to two spines of vertebra. Space between vertebral spines originally filled with new bone. In preparation of specimen it was soaked in acid to remove soft tissues; photographer undertook to improve specimen by boiling, consequently destroyed nearly all of the new bone.

Exp. 14. Showing result of spine of scapula transplanted and contacted to two vertebral spines one year and fourteen days after experiment. Notice bone filling in space between two spines from the graft, also evidence of absorption in the front end of the graft. False joint evidently from lack of immobilization, and also thickening of posterior spine, evidently due to throwing out of osteoblasts after scraping and trauma. Grease just under tip of this spine shows upper border of transplant.

passed into the muscles, left attached at the upper end, and the lower end left in the muscles without periosteal contact. Muscle wound closed with oo plain gut; skin with horse-hair. Removed his own stitches on the second day; wound opened and dog died of infection one week later. No post-mortem, the time having been too short to disclose anything of value.

THIRD: WILL BONE REPRODUCE BONE AND CONTINUE TO LIVE WHEN DEPRIVED OF PERIOSTEUM AND TRANSPLANTED INTO THE TISSUES WITHOUT CONTACT WITH LIVING OSTEOGENETIC TISSUE?

Experiment 6. February 10, 1913; brindle mongrel, four years old; weight 12 pounds; 2 puppies, one male and one female, nine days old. Male sacrificed with chloroform; both femurs of sacrificed puppy denuded of periosteum, cut in small pieces and transplanted as follows: *First:* One piece

Exp. 16. Showing remains of ulna transplanted and contacted with three vertebral spines after removal of periosteum; wire shows size of original transplant; no bony union at either end. Notice the rapidity of absorption at these points, and less evidence of absorption at point of bony contact. Lack of union probably due to insufficient trauma of spines and insufficient immobilization due to use of silver wire; holes showed where the other two wires were.

Exp. 17. Showing remains of puppy's split femur sixty-five days after being transplanted on to mother's femur; very little bone remaining. Wires showing original size of transplant, only partial union of graft, nearly all absorbed.

$\frac{5}{16}$ inch long by $\frac{1}{8}$ inch wide and $\frac{1}{16}$ inch thick, weight 4 gr. planted into the right loin inside the muscle sheath. Sheath closed with oo plain gut; skin with horse-hair. *Second:* Piece $\frac{1}{4}$ inch long, $\frac{1}{4}$ inch wide at broad end and $\frac{1}{8}$ inch wide at narrow end, weight $3\frac{1}{2}$ gr. into the right shoulder muscles inside sheath. Sheath closed with oo plain gut and skin with horse-hair. *Third:* Into the right thigh, cross section of femur $\frac{3}{8}$ inch in diameter, $\frac{1}{8}$ inch thick with medullary substance intact; weight 4 gr. inside muscle sheath. Sheath closed with oo plain gut, skin with horse-hair. *Fourth:* Into left thigh piece of femur $\frac{1}{2}$ inch long, $\frac{3}{16}$ inch wide, $\frac{1}{16}$ inch thick, weight 4 gr. inside muscle sheath. Sheath closed with oo plain gut. *Fifth:* Subcutaneously into left loin a piece of femur $\frac{1}{2}$ inch long, $\frac{3}{8}$ inch broad at wide end and $\frac{1}{8}$ inch at narrow end, $\frac{1}{16}$ inch thick, weight 2 gr. Skin closed with horse-hair. *Sixth:* Subcutaneously into left shoulder, piece $\frac{1}{2}$ inch long, $\frac{3}{16}$ inch wide at one end and $\frac{1}{8}$ inch wide at other end; weight 3 gr. Skin closed with horse-hair. Primary union throughout.

These experiments were made with a view of taking out a specimen every week or ten days for microscopical examination. Results: March 10, 1913, 28 days after experiment, under anæsthesia, the piece was removed from the left shoulder and was found to be adhered and encapsulated. As near as could be made out it was slightly smaller than when put in. Microscopical section showed cavities and fragmented nuclei marks of degeneration — no evidence of regeneration.

On March 23, 41 days after the original experiment, under anæsthesia a careful search was made for the piece in the left loin, but no traces of it could be found, not even a scar, evidently completely absorbed. The dog was sacrificed April 8, 57 days after experiment, and under the most careful dissection no traces of the transplants could be found, all completely absorbed.

Exp. 20. Showing bone fifty-four days after experiment, where two and one fourth inches of the ulna was removed, including all of the periosteum, the remains of which is shown in experiment 16. This space now measures one and one eight inches, one half its original length. Notice the greater amount of reproduction has been from the proximal end, probably due to the greater blood supply.

FOURTH: WILL BONE LIVE AND REPRODUCE BONE WHEN TRANSPLANTED INTO THE TISSUES, NOT DEPRIVED OF ITS PERIOSTEUM AND NOT CONTACTED WITH LIVING OSTEOGENETIC TISSUE?

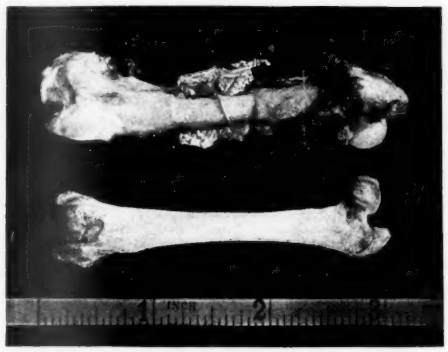
Experiment 7. March 10, 1912, small brown fox terrier, female, 4 months old; left spine of scapula with muscle attachments and periosteum planted into the left loin, within the muscle sheath; no contact with bone. Sheath closed with oo plain gut, skin with oo chromic gut. Primary union.

Sacrificed September 15, 1912, 6 months and 5 days after experiment. No trace of bone could be found after most careful dissection.

Experiment 8. March 10, 1912, spotted white and black female fox terrier 9 months old, weight 14 pounds; right spine of the scapula removed with muscle attachments, and periosteum left intact, the piece being 2 inches long and 1 inch wide at the broad end and ½ inch at the narrow end, planted into the right loin within the muscle sheath. No bony contact. Sheath closed with oo plain gut; skin with oo chromic gut. Slight infection. Healed in few days, evidently superficial.

Sacrificed March 24, 1913, being one year and 14 days following the experiment. Slight scar at site of operation, but upon most careful dissection no trace of the transplant could be found, completely absorbed.

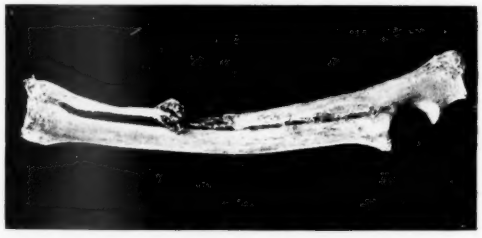
Experiment 9. January 5, 1913, brindle mongrel 4 months old, weight 15 pounds, left spine of scapula removed with muscle attachments and periosteum, planted into the loin on same side, inside muscle sheath. Sheath sutured with oo plain gut; no bony contact. Skin closed with horse-hair. The right spine was also removed with muscle attachments and periosteum intact transplanted into the right loin within the muscle sheath; sheath sutured with oo plain gut, skin with horse-hair. Primary union in both experiments.



Exp. 21. Showing both femurs one hundred and ten days after experiment. Growth in length equal. Tin foil and wire in place. Some restriction of bone under foil. Wire partially buried at linea-aspera. New layer of bone one-sixteenth inch thick over most of surface covered by foil.

Sacrificed February 21, 1913, 39 days after experiment. Fibrous band ¾ inch long found in the right loin. After careful dissection no bone could be found, evidently absorbed. In the left loin a piece of bone recovered one half its original size and encapsulated; as shown by the specimens, from which the spines were removed, the one from the right side which was found to be completely absorbed was only one half the size of the one planted into the left. This evidently accounting for the fact that the left piece was not absorbed because of its greater dimensions; it was greatly reduced in all dimensions, the edges being absorbed to a sharpness. In neither case was there any evidence of regeneration.

Experiment 10. January 5, 1913, twin dog to experiment 9, answering to same description. Left



Exp. 22. Sixty-eight days following experiment. Shows bending of radius, fibrous tissue filling gap, also silver wire indicating original size of transplant. No bony reproduction.

spine removed with muscle attachment and periosteum intact, transplanted into the left loin within muscle sheath without bony contact. Sheath closed with oo plain gut, skin with horse-hair. Right spine removed with muscle attachment and periosteum intact, piece being 1¾ inches long, 1 inch wide at the broad end and ½ inch at the narrow end; transplanted into the right loin within muscle sheath without bony contact. Sheath closed with oo catgut, skin with horse-hair.

Sacrificed March 24, 1913, 2 months and 19 days after experiment. After careful dissection, no trace could be found of the left spine; the right was recovered, being firmly adherent and encapsulated, piece being 1 inch long and ¼ inch wide at broadest place and thin as 2-ply note paper, being half its original dimensions, sharp edges showing evidence of absorption. No evidence in either case of production of new bone.

FIFTH: WILL BONE LIVE AND REPRODUCE BONE WHEN TRANSPLANTED AND CONTACTED WITH LIVING OSTEOGENETIC TISSUES?

Experiment 13. March 10, 1912, small brown fox terrier, female, four months old. Right spine of scapula removed with muscle and periosteum intact. The muscular attachments and periosteum were scraped from one side and this was contacted with two vertebral spines in the lumbar region; after they had been bared and the periosteum scraped away, the periosteum and muscular attachments were left on the opposite side of the transplant and it was fastened to the spine of the vertebræ with silver wire. Fascia was closed with oo plain gut; skin with oo chromic gut. Primary union.

Sacrificed September 15, 1912, 6 months and 5 days after the experiment. The transplant had lost its identity, the space between the two spines of the vertebræ being completely filled with new bone the same thickness of the spines. They were completely agglutinated together with bony tissue. The wires were still in place but buried with bony deposit.

Experiment 14. March 10, 1912. Small spotted white and black female fox terrier 9 months old. Left spine of the scapula measuring 2 inches long by 1½ inches by 1 inch, removed with muscular attachments and periosteum; the muscular attachments and periosteum were carefully scraped from one side, and this was placed in contact with 2 lumbar vertebral spines, after they had been thoroughly exposed and scraped, removing the periosteum. Contact was maintained by 2 clips, such as are used in closing the skin. Fascia closed with oo plain gut; skin with oo chromic. Primary union.

Sacrificed March 24, 1913, one year and 14 days following the experiment. Extensive proliferation of bone; interspace between the spines filled with bone same thickness of spine; front end of transplant showed some evidence of absorption; tip of one spine twice its original thickness, this probably due to scraping causing outpouring of osteoblasts; a peculiar thing about the specimen being a false joint formed between the anterior spine and its contact with the graft. Outline of graft lost.

Experiment 15. January 14, 1913, black mongrel 4 months old, weight 20 pounds. The right ulna removed, including the periosteum, this afterwards scraped off and the periosteum scraped from the left side of three lumbar vertebral spines. The ulna was wired to these, a hole being drilled through each spine, the wire thrown around the transplant; fascia closed with oo gut and skin with oo chromic gut. Extensive infection and dog killed 9 days later. No post-mortem.

Experiment 16. January 17, 1913, black mongrel 4 months old, weight 20 pounds, 2¼ inches of right ulna removed, periosteum scraped from one side only, contacted to three lumbar spines by three wires on the left side, after periosteum being removed from the spines; wire thrown completely around transplant, no holes being drilled in it, holding it firmly to the spines; fascia closed with oo plain gut, skin with oo chromic. Primary union.

Sacrificed March 13, 1913, being 56 days following the experiment. No visible scar in the skin, the wires through the two front spines were broken, back wire still in place, but much too large loop for the present implant. No union between the implant and posterior and anterior spine; bony union between the middle spine and implant. The implant measures 2⅛ inches in length, much reduced in diameter, thoroughly honeycombed, especially marked at each end where there was not bony union, showing evidence of rapid absorption. Specimen larger in the center where there was bony contact, and evidence of absorption not so well marked; transplant not more than half its original diameter. Immobilization incomplete, no union in two points, showing silver wire not to be satisfactory for this work.

Experiment 17. January 19, 1913, spotted fox terrier 13 months old; right femur bared, scraped, two holes bored through it and one half of split femur from her own pup three weeks old, including the diaphysis only, placed on this surface, with the split side contacting; two silver wires were thrown completely around it, holding it to the femur. No holes were bored in the transplant. Muscles were sewed over it with oo plain gut, fascia, oo chromic gut and wound closed with oo chromic gut. No splint or other form of immobilization was used. Primary union.

Sacrificed March 24, 1913, 65 days after experiment. Transplant nearly all absorbed, two wires still in place, showing original size of the transplant, a small piece of transplant 1 inch long still remaining at the lower end, still being about ¼ inch wide at widest end, running into a point at thinnest, being $\frac{1}{16}$ inch. The surface of femur where scraping was done transplant made slightly irregular and roughened, showing new deposit of bone, the parts remaining were where best union had occurred; the surface of the transplant being somewhat irregular it was impossible to get perfect contact throughout. No evidence of reproduction of bone in the graft.

Experiment 18. January 19, 1913, spotted fox terrier 13 months old; left femur bared, scraped, two holes bored through it and one half of the split femur from her own pup three weeks old, including diaphysis only, wired to this surface, the split side contacting. Wires thrown completely around the transplant; no holes drilled in it; muscles sutured with oo plain gut; fascia with oo chromic gut and skin with oo chromic; no effort made to immobilize leg. Primary union.

Sacrificed March 24, 1913, 65 days after experiment. Transplant nearly all gone, leaving principally an irregular, rough surface on the femur. This transplant was more nearly absorbed than the one just preceding, and was likely smaller to begin with; the wires were still in place, which showed the original size of the transplant. What small particles of the transplant remain are rough and honeycombed, showing that absorption is going on. The surface of the femur that was scraped was somewhat roughened, no evidence of reproduction of the bone from the transplant.

SIXTH: WILL BONE REPRODUCE BONE WITHOUT THE AID OF PERIOSTEUM?

Experiment 19. February 21, 1913, young black and tan hound, weight 15 pounds; right femur was exposed, all of periosteum removed to near the epiphyseal line and silver wire ring was placed around the center of the femur, and this was covered with 4-ply tin-foil wrapped completely around the bone, covering an area of 2 inches in length; this to prevent the muscles or other tissues from coming in contact with the bone deprived of its periosteum. This tin-foil was tied around the bone at each end with 0–10 day chromic catgut; muscles were sutured in place with oo plain gut; skin with horse-hair; collodian and cotton dressing. Removed his own stitches on the second day, wound opened and dog died of infection one week later. No post-mortem.

Experiment 20. January 17, 1913; black mongrel 4 months old, weight 20 pounds. Right ulna removed, not disturbing either epiphyseal line, being cut out with bone forceps, taking the entire periosteum with it, the piece measuring 2¼ inches in length; muscles not sutured; fascia closed with oo chromic gut; skin oo chromic gut. Primary union.

Sacrificed March 13, 1913, 54 days after experiment. Space in ulna only 1⅛ inches in length, only half of its original length. There had in 54 days been reproduced 1⅛ inches of bone, and this almost wholly from the proximal end. This is interesting because of the fact that the nutrient artery enters the bone at the proximal end, thereby giving this part more blood supply. This new growth of bone ran out to a sharp point, where it terminated, both at the proximal and distal ends.

Experiment 21. February 20, 1913, mongrel pup of small breed, about 4 weeks old; weight 2¼ pounds. Right femur exposed, all the periosteum removed between the epiphysis, silver wire ring put around femur in the center, tin-foil 4-ply wrapped around the femur for a space of ¾ inch, this being about as long an area as possible to use because of the small size of the bone; tied around at each end with 10-day chromic gut to hold it in place so that it would not be disturbed by the muscles until adhesions formed around it; femur measuring 2 inches from tip to tip, including the joint surface. Muscles closed with oo plain gut and skin with horse-hair. Primary union. X-ray plates made May 3, 1913, 73 days following the experiment, showed the tin-foil and silver ring in perfect position, and the bone to be growing normally, as compared with the opposite femur; impossible to tell whether or not the silver ring had been covered with bone, because of the density of the tin foil.

Sacrificed June 10, 1913, 110 days after experiment. The right femur was found to be the same length as the opposite, measuring 3 inches, having grown in length one inch since the experiment. The tin-foil was in position as originally placed. It had constricted the

growth of the bone, the new deposit at the upper end showing a decided line of demarkation. There was a deposit of new bone $\frac{1}{16}$ inch thick extending half way around the part covered with the foil, the silver ring was partly covered in the region of the linea aspera; otherwise there was no deposit surrounding it. While there was growth of bone under this foil it was very greatly restricted, probably because the foil had been wrapped twice around the bone and restricted the reproduction mechanically from pressure. The bone grew in length, keeping pace with the opposite femur and functionated perfectly. The puppy never showed any evidence of disability after the first few days following the experiment.

Experiment 22. April 2, 1913, small old black and white mongrel, female, has pup 9 days old; ¾ inch of the right ulna removed including all the periosteum, gap filled with femur of pup, end to end contact; periosteum all removed from transplant, held in place at upper end by being beveled and placed in medullary cavity after this had been reamed out. Lower end held in place by fine piece of silver wire; muscles sewed closely over implant with oo plain gut, skin with horse-hair; collodian dressing, bandaging and wood fiber splint. Pup's bone was so soft that it could be cut with scissors; each articulating end was cut off of the implant. Dressings remained in place nicely, and primary union.

Sacrificed June 10, 1913, 68 days following the experiment. There was found some bending of the radius due to the lack of support from the ulna; the silver wire at the lower end of the transplant was still in place showing the original size of the puppy's femur. There had been no bony reproduction from the transplant and nothing remained in the gap but a fibrous cord. Result same as other experiments with young bone. Experiments 17 and 18 showed no evidence of reproduction, though in contact with living bone.

Experiment 26. April 8, 1913, small white female mongrel; weight 6½ pounds; right ulna bared; all the periosteum removed; completely separated from its close proximity to the radius, and a piece 1 inch long removed from the lower third; remainder of the shaft left in the muscles without periosteum and without other bony contact. Bleeding occurred from proximal end of the shaft; muscles sutured, oo plain gut; skin with horse-hair, collodian dressing covered with bandage and adhesive plaster; object of this experiment being to determine if this ulna will grow out from the proximal end as it did in experiment 22, where the periosteum and bone had been cut off evenly, no periosteum whatever being left in this case. Primary union.

Sacrificed June 10, 1913, 62 days after the experiment. The gap between the ends of the bone measures slightly less than ¾ inch. The proximal end of the ulna shows evidence of regeneration for a distance of ¼ inch, distal end absorbed to a sharp point, radius bent somewhat due to lack of support from the ulna; as in experiment 20, all of the reproduction was from the proximal end.

SEVENTH: IS IT ESSENTIAL THAT THE TRANSPLANT HAVE A FUNCTION IN ORDER TO BE PERMANENT?

This question came up because we had observed in experiments 17 and 18 where the puppy's split femur had been contacted with its mother's bared femur had become partially united, and later absorbed. This would suggest the possibility that absorption had taken place because this transplant had no function to perform. We then conceived the idea of doing the following:

Experiment 23. April 1, 1913, black and white mongrel 4 months old, weight about 18 pounds. Right femur exposed; a section of bone taken out of the center of it, including one third its diameter and 2½ inches in length; the periosteum not disturbed and muscular attachments not disturbed. This was split off from the shaft of the bone, turned back into the muscles, the periosteum acting as a hinge; the muscles drawn down between it and the shaft of the bone, and from which it had been split, and sutured in place to prevent it having any bony contact. Muscles closed with oo plain gut; skin with horse-hair. All that was done in this case was to throw the section of bone out of function without disturbing the periosteum or circulation any more than possible. Of course the circulation to a considerable extent was interfered with. Collodian and cotton dressing, bandage and adhesive plaster. It was learned from the keeper immediately after operation that this dog and its mate had both been sick for several days with diarrhœa. He seemed to never recover from the operation, and died on the 7th day. No post-mortem was made, being too early to be of value.

IS PERIOSTEUM ESSENTIAL TO THE LIFE AND GROWTH OF BONE?

Experiment 11. January 8, 1913, white and tan fox terrier, age unknown. All of periosteum removed from the right femur; muscles and sheath closed with oo plain gut; skin with horse-hair. Primary union.

Sacrificed February 7, 1913, 30 days following the experiment. Upon exposing right femur it was found that the muscles were firmly attached to it by a thin fibrous membrane resembling in every way the normal periosteum, except possibly more firmly adherent to the bone. The bone was smooth and healthy in every respect, showed no evidence of having suffered because of removal of the periosteum.

Experiment 12. January 8, 1913, small black and white mongrel dog; age unknown. Right femur bared, all of periosteum removed, muscles closed with oo plain gut; skin with horse-hair.

Sacrificed February 7, 1913, 30 days after the experiment. Description same as in No. 11; the bone showed no evidence of having suffered because of loss of periosteum, and had a firmly adherent fibrous membrane resembling the original in every way except slightly more adherent.

Experiment 24. To further determine whether or not young bone would reproduce itself when transplanted free into the tissues without bony contact, the two following experiments were made from the bones of dog's own puppy. Black and white spotted fox terrier 13 months old; her own puppy 3 weeks old sacrificed with ether, and piece 1 inch long of the tibia was placed into the muscles of the back within the muscle sheath; another piece 1 inch long of the fibula from the same leg of the puppy was placed in the opposite side in the same way; neither implant having any bony contact. The periosteum and articular ends were removed from both. The wound in the right side of the back where the tibia was transplanted was infected and the transplant was either destroyed or thrown off. The tissues evidently not as tolerant of large free transplant as of the small. Primary union in the left wound where the fibula was implanted.

Sacrificed March 24, 1913, 65 days after experiment. After careful dissection no evidence of bone in the right side of the back where the tibia was transplanted; small piece of fibula was recovered from the left side.

Experiment 25. April 2, 1913, small old black and white mongrel female; has puppy 9 days old. Piece of split femur ½ inch long planted subcutaneously in the right loin; skin closed with horse-hair. Primary union.

Sacrificed May 3, 1913. The specimen recovered was almost as long as when transplanted, but was much smaller in every other diameter, showing evidence of rapid absorption.

TECHNIQUE

In all of our earlier experiments we used ether anæsthesia preceded by morphine $\frac{1}{12}$, hyacine $\frac{1}{400}$, two doses hyperdermically half hour apart preceding the anæsthesia. We found these dogs did not take the anæsthetic any better and were often very nauseated and noisy following the operation. We then adopted the plan of giving straight ether and never had a fatality and the dogs were much more quiet following the operation. Our routine method of preparation of the skin was to shave it after the dog was anæsthetized, cleansing with alcohol, followed by the liberal use of iodine. In the entire series we only had two primary infections.

We owe our appreciation and thanks to Dr. M. B. Wesson for valuable assistance and administering of the anæsthetics, at which he is an expert.

CONCLUSIONS

1. We were unable in any experiment to reproduce bone from free periosteal transplants into the subcutaneous tissue and muscle.

2. We were unable to reproduce bone in the periosteal flap raised, left in contact with the bone, passed through muscle and again contacted with periosteum, with the one single exception where there was a small nodule of bone formed apparently in the free end of the flap, corresponding to another nodule formed on the shaft of the bone opposite, leading us to believe that the bone in the tip of the free periosteal flap was osteoblasts raised from the corresponding area on the shaft of the bone and also because no bone had formed anywhere else in the flap.

3. We were unable to reproduce bone in any experiment from free bone transplants, without periosteum, into the subcutaneous tissue and muscle, regardless of the age of the transplant. Absorption was the rule in every case.

4. We were unable to reproduce bone in a single experiment where bone was transplanted free, periosteum left intact, into the muscle or subcutaneous tissue. These transplants were uniformly absorbed.

5. We were uniformly able to reproduce bone when transplanted and contacted with

living bone, if it were in position where it had a function to perform, except experiment 22, where transplant was only 9 days old.

6. Other necessary conditions being present for its reproduction, bone reproduces bone without the aid of periosteum.

7. Our transplants that were contacted with living bone and had no function to perform were inclined to absorption.

8. While periosteum may be an aid to the life and growth of bone, we were not able to prove in any experiment that it was at all essential.

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## FACTORS INFLUENCING THE MORTALITY OF SUPRAPUBIC PROSTATECTOMY

By HUGH CABOT, M. D., Boston
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MUCH as I should like to hold a contrary view, I still believe that the operation of suprapubic prostatectomy has a higher mortality as at present performed than when the operation is done by the perineal route. The high operation is, I believe, far more efficient and for this reason we might be willing to accept a higher risk, but not until it appears that we have reduced the mortality to the lowest possible figure compatible with efficient work. There are three factors which contribute most importantly to the mortality of operation and to these I would direct your attention. These are the anæsthetic, the shock, entirely apart from bleeding, and the bleeding itself.

*Choice of anæsthetics.* For practical purposes in this country the choice of anæsthetics is limited to three at the present time. Ether, gas and oxygen, and spinal anæsthesia. Perhaps because I come from the birthplace of ether I have learned to dread it as an anæsthetic for people past middle life. We have been in the habit of falling back upon the very flattering statistics of ether anæsthesia because we have been far too prone to deal only with immediate mortality. It is no new conception to you that the danger from ether is largely in its tendency to irritate the mucous membrane of the lung. Patients requiring prostatectomy are peculiarly likely to have lung conditions likely to resent irritation, particularly chronic bronchitis, emphysema, or even moderate œdema of the bases. If we add in as part of the mortality of the anæsthetic the cases which ultimately die from acute brònchitis, bronchial pneumonia, or even frank pneumonia after prostatectomy, I believe that we shall inevitably come to regard ether as not the safest but probably the most dangerous of general anæsthetics.

*Gas and oxygen.* Of late years the advance in our ability to manage gas and oxygen has increased enormously and it is now among the most valuable at our disposal. It has, however, certain perfectly distinct disadvantages when applied to this class of cases. It is not a safe anæsthetic for patients with diseased hearts and these are admittedly common in this class of patient. Moreover, the mere mechanical difficulties of administration to these lantern-jawed, full-bearded people is by no means inconsiderable and these objections to my mind go far to vitiate its value as the anæsthetic of election.

*Spinal anæsthesia.* There can be no question that this method of anæsthesia is the ideal one if we come to believe that it is as safe or safer than those with which it must be compared. It obviously removes the dangers attendant upon general anæsthesia in patients with damaged hearts or lungs and we have no reason for believing that it exerts an unfavorable influence upon the action of the kidney. We come down, therefore, directly to the question of the risk. I believe that statistics are now at hand from reliable

sources extending over a term of years to show that this method of anæsthesia carries no considerable danger. I have been unable to find evidence that the mortality is more than one in a thousand, but even if we were to admit a mortality of one in five hundred it would still have a long lead over any form of general anæsthesia. Looked at purely from its anæsthetic qualities, I believe it to be no more dangerous than the other anæsthetics and for reasons which will shortly appear I think it to have commanding advantages.

*Shock.* In any discussion of shock we should, I think, sharply distinguish the shock which arises from trauma and that which appears in connection with loss of blood. At this point I desire to confine the word shock to that which has no relation to bleeding. It seems to me clear that the shock of the suprapubic prostatectomy is considerably greater than that of the perineal operation, done with equal skill. This must be due to damage to nerve endings to the tissues traversed by the operation and therefore chiefly to the tissues of the abdominal wall and of the bladder wall itself. It is not clear to me why the manipulation of the prostate, whether from above or below, should be essentially different in this regard, though there is some evidence to show that such is the case. The work of Crile in the elimination of shock, and the late results of shock, is doubtless familiar to all, and his method of operating under what he has called anoci-association has been widely discussed. The soundness of his general conclusions seems to me so clear as to be convincing and I have for a considerable time adopted his technique in all abdominal operations, but this technique does not seem to me thoroughly applicable to operations upon the prostate. I have not been able by his method to obtain efficient "block" of the structures in the neighborhood of the prostate and it has not seemed to me that the anæsthesia of the bladder wall was complete. The only absolutely satisfactory method of completely blocking nerve stimulæ from this region is spinal anæsthesia and since I have employed this as a routine measure for all operations upon the prostate the elimination of shock has seemed to me absolute. These patients go through operation without change in the character of the pulse and I have been unable to see that the operation had any effect upon their nervous mechanism.

If the observation of others bears out this view it will go far to clinch the supremacy of spinal anæsthesia for these operations.

*Bleeding.* It has, of course, been generally recognized that the control of bleeding was an important factor in the success of operation and yet I do not think that recognition has been as complete as the situation requires. We have been too likely to be satisfied with control of bleeding to such an extent that it did not obviously cause the death of the patient and have not been sufficiently alive to the fact that loss of blood is a factor in mortality through its ability to lower general resistance. The ability of these patients to successfully withstand operation rests upon a very delicately balanced mechanism and any extra load thrown upon them from any source may tip the scale. Infection in one form or another is an important factor and this at the last analysis depends far more upon lowered resistance than upon the actual contact of bacteria with raw surfaces. We have taken considerable trouble to avoid the more gross forms of wound infection and have planned our operations with this in view, overlooking the fact that the resistance of the patient is a far more important factor. More and more I have been impressed with the fact that if we avoid disturbing the balance of the protective mechanisms which guard the patient against infection through faulty management of anæsthetics, prolonged traumatic operations, and loss of blood, it matters little by what precise technique we achieve the result. These patients may be compared, in regard to their ability to lose blood, to children in whom we recognize the fact that operation must be done "as dry" as possible. I wish, therefore, to discuss in detail the methods of controlling bleeding because they do not seem to me to have been as efficient as the situation requires.

*Usual methods of controlling bleeding.* A very considerable number of operators by the suprapubic route cannot properly be said to take any method of controlling the bleeding

and are content with the uncertain contractility of the structures from which the masses have been removed and the formation of thrombi in the veins. This method, or lack of method, seems to me altogether too haphazard and if we believe that loss of blood should be reduced to a minimum we cannot assent to this method of trusting to the unknown abilities of the individual patient. Next in order of frequency probably comes the use of irrigations, either hot or cold, either constant or intermittent. This method appears to me no great improvement over nothing for while it undoubtedly has a tendency to check bleeding partly by the actual temperature of the irrigating fluid and partly by keeping the bladder free from clots, which will cause dangerous distention, it is altogether too inaccurate to stand the demands of a scientific surgical procedure. Although with its use most patients will recover, some patients will be lost through actual loss of blood or the more elusive results of bleeding commonly put down in the records as sepsis, pneumonia, or other form of infection.

*Packing.* A more accurate and certain method of control is to be found in the use of gauze packing in various forms. A considerable variety of methods have been employed, all more or less efficient. The older and more crude method of packing gauze directly into the cavity and bringing it out through the wound without providing other drainage of the bladder is open to the great objection that it leaves the patient constantly wet and exposes the freshly traumatized tissues to the contact of more or less infected urine. It is an unnecessarily crude method. The better method is that employed by Mitchell, Davis, and others of using a long, narrow strip of gauze which is then brought out through a good-sized suprapubic tube, either metal (Davis) or rubber, around which the bladder wall can be closed snugly and the wound kept dry. In due time the gauze is removed through this tube without disturbing the drainage of the bladder. This is to my mind the most efficient method of packing and would be that of election except for the fact that packing seems to me objectionable no matter how well done. Packing necessarily means tissue necrosis. Tissue necrosis invites infection and infection is on the whole the largest factor in mortality. If the bleeding can be controlled in no other way then packing must be the choice, but I am firmly of the opinion that it can be efficiently controlled by far better means and upon a more accurate knowledge of the sources of this bleeding will depend our ability to control it.

*Sources of bleeding.* It has, I think, generally been assumed that the important bleeding came from the veins lying in the sheath of the prostate, the so-called periprostatic plexus. It has been too little recognized that the most important bleeding was arterial and not venous, important because more difficult to manage. With a larger incision in the bladder wall, which it has been my habit to employ during the last year, ample opportunity has been given of seeing exactly where the blood comes from and I have been surprised to note that it came largely from the upper portion of the wound where the masses were separated from the muscular structures of the bladder neck. There are often good-sized "spurters" coming from just beneath the torn mucous membrane at the bladder neck and the amount of actual bleeding from the cavity has been comparatively small. With these facts in view, I have come to believe that some form of suture will be found the most efficient method of controlling bleeding, and I have employed a considerable variety with a more or less measure of success.

*Methods of applying sutures to the neck of the bladder.* In order that this may be done with any efficiency, a much freer incision in the bladder wall is necessary than has been customary in the past. In other words, a thoroughly good exposure of the field must be had. It will be objected that this unnecessarily prolongs the time of operation and increases the trauma of the operation. To this it may be answered that under spinal anæsthesia time is comparatively cheap, as the patient is subject to no strain and the difference of ten or fifteen minutes in the length of an operation is, I believe, negligible. Moreover, the shortness of many of the

operations in which enucleation is done through a small suprapubic incision is more apparent than real, because when the patient is returned to bed the operation is not in any proper sense finished. Bleeding is still going on, often of a considerable amount, which is depriving the patient of that which he needs, his blood, to a far greater extent than would a moderate continuance of the operation resulting in a dry wound. Our ideal in these cases should be to get the bladder so dry that we could close it without drainage, though I believe such a closure to be in the highest degree unwise. A good exposure of the bladder must be obtained. The masses are then removed by enucleation and with retractors in the bladder and the foot of the table more or less elevated the source of bleeding is sought for. As I have already pointed out, this comes in considerable part from the bladder neck and to this region sutures should be applied. I have not been able to make any efficient application of sutures to the walls of the cavity with a view to its obliteration and incline to regard this as anatomically impossible owing to the fixed relation of the lateral wall to the pubic arch. I have, however, gotten efficient control of bleeding by whipping with a catgut suture what may be termed the neck of the bladder. This may be done by carrying a small, rather full, curved needle down into the cavity from which the prostate has been removed and bringing it out through the lateral wall close to the pubic bone on one side or the other, including all the muscular structures of this region. In this way a considerable bite of tissue is obtained. The suture is then carried toward the floor of the bladder as a continuous suture and is stopped just short of the middle line. The same procedure is carried out on the opposite side, thus to a greater or less extent puckering up the bladder neck. In some cases where there is considerable laxity of the tissue this puckering will result in more or less diaphragm formation. When this occurs the diaphragm should be cut through on the floor either with scissors or the cautery and any bleeding resulting from this maneuver controlled either with suture or cautery. The result of this suture is to considerably narrow the bladder neck, at the same time giving free drainage on the floor at the lowest point. What is far more important, as a result, is that the bleeding is efficiently controlled and no packing is required. Further experience is necessary to simplify the method and it may well appear that some other plan of applying sutures will be better. I am not wedded to this or any other particular method, but am much impressed with the efficiency of suture in some form and regard it as the most certain method of controlling what I am convinced is the most important factor in mortality. The operation is finished by the closure of the bladder wall by suture around a medium sized drainage tube and it has been our custom to leave an inlying catheter in the urethra through which the bladder could be irrigated both for the purpose of accurate knowledge of the amount of bleeding and to prevent absorption in cases where the bladder is seriously infected.

In closing I want to urge strongly the importance of paying attention to the three important factors at present influencing the mortality of suprapubic prostatectomy; the anæsthetic, the production of shock by traumatic operating, and the inefficient control of bleeding. When these factors are reduced to a minimum as sources of danger, suprapubic prostatectomy will be the method of election for all cases of adenomatous enlargement of the prostate, and the perineal operation will have passed quietly into history.

# THE EARLY DIAGNOSIS OF CANCER OF THE ŒSOPHAGUS[1]

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STATISTICS prove that cancer of the œsophagus is a frequent disease. Like other cancers of the gastro-intestinal tract it has three stages of development. In its first stage it is simply a disease of the mucous membrane, a polypous growth in the wall of the œsophagus that protrudes into its lumen, or else an ulcerating infiltration which gradually involves the submucosa and the thin muscular coat. Symptoms of stricture are still absent, but there may already be difficulty in swallowing, and, on account of change of food, loss of weight. When the cancer in its growth has encircled the œsophagus, constricting its lumen, the second stage has been entered upon. The difficulty in swallowing becomes more pronounced; submucosa and muscularis have become thoroughly infiltrated, unelastic and unyielding; but still the cancer is confined to the œsophagus proper, although some of the lymphatic glands may have become involved. The third stage sets in with the reaching out of the growth beyond the walls of the tube, its becoming adherent to the neighboring organs; e.g., the aorta, bronchus, lung, etc., and particularly to the pneumogastric nerves.

Clinically, this carcinoma is the most benign of all occurring in the entire gastro-intestinal tract. It remains locally confined for a comparatively long time, infects the glands at a late period, and metastases appear only in the advanced stage.

If treated palliatively, the time between first symptoms and exitus is ordinarily from twelve to fifteen months.

If treated radically, our real hope for a successful issue lies in our getting the chance to operate during the first stage, and our most energetic efforts should be exerted and directed toward impressing upon the medical fraternity as well as upon the laity the danger of temporizing with an impediment between mouth and stomach, and the urgent necessity, in such cases, of promptly establishing a strict diagnosis.

If a patient presents himself with the complaint that he has difficulty in swallowing, or that he regurgitates part or all the food he swallows, the following affections may be present: diverticulum of the œsophagus, cardiospasm, narrowing of the lumen of the œsophagus by pressure from without (swollen glands, aneurism, tumor of the mediastinum, exudate within the pericardium), cicatricial stricture due to swallowing of a caustic, the rarer strictures following tubercular or specific ulcerations or a peptic ulcer at the cardia, finally cancer.

As to frequency, the rotation is reversed, cancer standing at the head of the list.

The means of making the differential diagnosis, next to a most careful clinical examination, are sounding, œsophagoscopy, radiography with fluoroscopy, and exploratory thoracotomy.

## I. SOUNDS

A modern œsophageal sound should be part of the equipment of every physician; a very commendable one is that devised by Callmann,[1] originally designed for examination of the rectum. The usually employed olive sounds demonstrate the existence, location, and degree of the stenosis, but fail to indicate its length. A steel rod, with mushroom tip, so shaped that it will not cause pain if moved downward or upward, has proven very practical. (Fig. 1*a*.) Callmann found that the œsophagus from pharynx to cardia, if normal, gives to the fingers guiding the sound the impression of a soft, smooth and elastic surface; the mucous membrane closes in upon the head of the sound and thus is palpated direct. Wherever the tissue is changed by either benign or malignant causes an uneven surface is felt. Therefore, when difficulty in swallowing exists, but the œsophageal wall

[1] Deutsche med. Wchnschr., 1911, p. 497.

[1] Read before the sixteenth annual meeting of the American Gastro-Enterological Association, Washington, D. C., May 5, 1913.

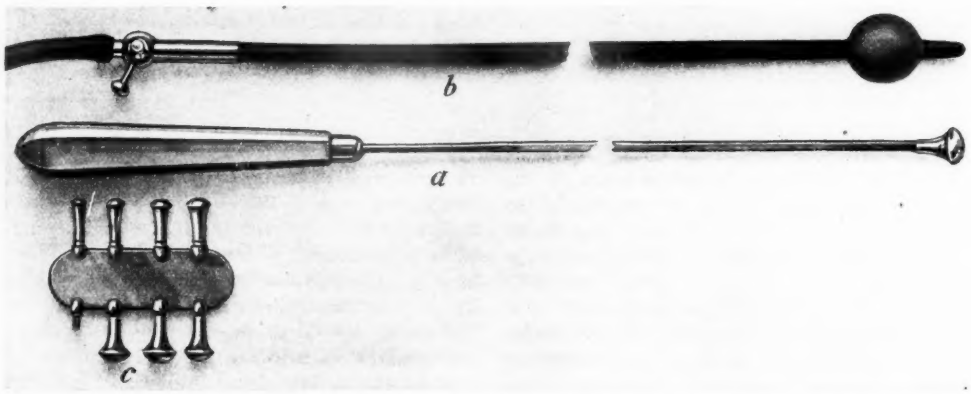


Fig. 1. (*a*) Callmann's œsophageal sound with mushroom tip. (*b*) Schreiber's œsophageal sound for retrograde exploration. The collapsed bulb is filled with water after it has reached the stomach. (*c*) Interchangeable tips for Callmann's sound, representing sizes 15 to 36, French gauge, the increase being 3 millimeters each.

feels even and smooth in its entire length, there is probably no cancer present.

This sound is especially advised for use in nervous patients, where it is difficult to distinguish between spastic and neoplastic stenosis; further, where the organic stenosis is accompanied by spasms of the muscularis, the symptoms of the latter overshadowing those of the former; finally, in the initial stage of cancer where there is no pronounced stricture.

As regards the cardia, it should be noted that the healthy cardia is frequently passed with a slight jerk.

Another very good sound is that of Schreiber.[1] It is built for retrograde exploration and gives reliable information of a stenosis which it would be hard to detect by the ordinary sound. It is a rubber sound to which a small bulb is attached (Fig. 1*b*). After introduction into the stomach, water is filled into the bulb; thus distended, it is slowly pulled upward and moves smoothly where the œsophagus is normal. Diseased spots arrest its passage and hold it so tightly that even quite a strong pull will not budge it. Schreiber found that from 80 to 90 per cent of all the stenoses he examined were of cancerous nature, spasm being the least frequent cause of stenosis in the remaining 10–20 per cent.

[1] Berl. klin. Wchnschr., 1911, No. 25. Schreiber's as well as Callmann's sound were presented before the Association.

These sounds have been dwelt upon somewhat at length, because they can be made use of by every physician. Other methods of examination are œsophagoscopy with extirpation of a small piece for microscopic examination,[2] radiography with fluoroscopy, and exploratory thoracotomy. Œsophagoscopy and radiography are best done by the specialist, or at institutions. Highly important and absolutely indispensable though they be, they are here not specially considered, although, as regards radiography, a proposition lately made by Bassler [3] of New York, should be briefly mentioned. He makes use of a special sound, with rubber bulb at its end which, after being introduced into the stomach, is distended and pulled into the cardia. It occludes the latter and permits the bismuth meal to stay within the œsophagus. He believes that pathologic changes within the tube will thus be recognized in the very early stage of the trouble. The idea seems to be a good one and it would certainly be highly gratifying if its practicability could be successfully demonstrated in the near future. It would mean a great enhancement of the diagnostic value of the X-rays in this class of cases.

[2] The question, whether the removal of a piece of the tumor for microscopic examination is an absolute necessity before thoracotomy can be advised, as some surgeons demand, is still under discussion. Personally, I lean toward Lexer's view, who considers this probatory excision "entirely superfluous" and often directly dangerous, as it favors perforation of the œsophagus with posterior mediastinitis. (München. med. Wchnschr., 1911, No. 29, p. 1550.)

[3] J. Am. M. Ass., 1913, lx, No. 17, April 26.

Exploratory thoracotomy takes the same place in the surgery of the thorax as exploratory laparotomy does in abdominal surgery. It has been definitely proven, that under differential pressure it can be carried out with the same amount of safety as the latter.

The principal point of the whole question is, that a patient who complains of difficulty in swallowing must, by mutual consent of physician and surgeon, be considered a serious case, a case that may need prompt radical surgical treatment as his only chance: "*aegroti salus prima lex!*" As soon as the physician has become suspicious of an œsophageal stenosis, he should insist on a strict diagnosis, and if carcinoma is found, the case is a surgical one. If doubt remains, exploratory thoracotomy is clearly indicated and the surgeon must be prepared to do radical work, in case malignant disease be found.

It is true, death *may* come more quickly if the patient submits to radical operation, but it will also inevitably come within a few months under general treatment. On the other hand, under surgical treatment, death may not come at all; the patient may emerge from the operation with the ability of swallowing restored and in condition to again enjoy life and go about his daily work. Proof for this assertion are the following cases:

Sauerbruch a few years ago had a patient who lived fourteen days after resection of the œsophagus and œsophago-gastrostomy by means of the button; the man then died of acute pneumonia of the right lower lobe.[1]

Last year Ach had a patient recover after resection of the œsophagus for cancer in its lower third, but also had the hard luck to see him succumb owing to insufficiency of the gastric fistula.[2] He died on the seventeenth day after operation.

Within the last twelve months the surgery of cancer of the œsophagus has progressed at a tremendous pace. In the course of the first ten weeks of 1913, two patients have entirely recovered from the operation. Zaaijer of the University of Leiden, Holland, successfully resected a cancer of the cardia which involved the lower portion of the œsophagus and cardia (1913, Jan. 13),[3] and Torek of the German Hospital of New York successfully resected a cancer situated behind the aortic arch (1913, March 14).[4] Both were early cases; in both the pneumogastric nerves could be dissected off the tumor.

These successes are truly inspiring, for now at last the proof has been rendered that such patients have a chance, nay, even a good chance, to pull through, *if they reach the surgeon early*, and furthermore, that tumors not only in the lower third, but situated *in any portion* of the œsophagus are amenable to resection with fair hope of success.

Incidentally, the operation for constructing a new tube through which the patient may swallow has been greatly advanced. Jianu's method of gastrostomy, devised in 1912, in which the major curvature of the stomach is used for the formation of a tube representing the lower part of a new œsophagus, has become a firmly established operation. The free end of this tube can be nicely pulled up extra-thoracically to the level of the third, if not second left costal cartilage.[5] When thereupon in the second sitting the œsophageal growth within the thorax is resected, the oral stump is no longer inverted, and left *in situ*, but transposed outside under the skin of the thorax. For this purpose an incision is made down to the œsophagus above the clavicle. If the ends of these tubes, the one pulled up from below and the other one pulled down from above, meet, they may at once be united; if they are short, a rubber tube, according to the Gluck-Perthes method, may be employed for their connection, or a skin-plasty will complete the extra-thoracic œsophagoplasty.

It even seems possible, according to our experience in experimental surgery, to make use of this Jianu-tube for intrathoracic œsophagoplasty, when the seat of the tumor is in the lower third, by pulling it up alongside the cardia — which was closed by sutures in the course of the resection — into the thorax and there have it replace the removed lower third of the œsophagus. The same, of

[1] Sauerbruch-Schumacher, Technik der Thorax-Chirurgie, p. 87.

[2] Alwin Ach, Beitr. z. Œsophagus-Chir., 1913, p. 68, etc.

[3] Beitr. z. klin. Chir., lxxxiii, 2 p., 419.

[4] J. Am. M. Ass., lx, p. 1533.

[5] Three patients, recently operated upon by me according to this method, have given a very satisfactory result.

course, applies if the cardia as such was involved with the adjacent parts of the lowest portion of the œsophagus.

In cases in which the cardial portion of the stomach has been encroached upon by the malignant tumor, at the cardia, Jianu's tube could hardly be made long enough without getting too close to the affected field. For such cases, v. Fink's proposition, recently brought out,[1] to make use of the entire stomach inclusive of the horizontal portion of the duodenum for the inferior œsophagoplasty, would come into consideration. The stomach and proximal end of the duodenum, properly mobilized, can be pulled up nearly to the clavicle and later united with the transposed proximal œsophageal stump. An additional posterior gastro-enterostomy takes care of the proper passage of the food swallowed through the new extra-thoracic œsophagus.

Thus we can now claim to be able, *in an early case*, not only to remove the malignant tumor from any portion of the œsophagus, with reasonable hope of success, but may at the same time fulfill the wish, which, next to life, is the most ardent one of these patients —to give them back the ability to swallow.

[1] Zentralbl. f. Chir., 1913, April 12.

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## RENAL FUNCTION[1]

By B. S. BARRINGER, M. D., New York City

FROM 12½ to 25 per cent of all operative deaths following nephrectomy are due to renal insufficiency, to an improper estimation of the reserve force of the remaining kidney. In a certain number of cases the kidney function as measured by our present tests and particularly phenolsulphonephthalein, varies with the destruction of the kidney tissue. The higher the output of phthalein the better is the kidney able to withstand nephrectomy of its fellow. In certain other cases there occurs what might be termed "sports" in which a kidney of normal or practically normal function as estimated by phthalein, by urea, or by any other known test, utterly refuses to bear out these tests and the patient dies anuric. As far as one can judge the deaths in this latter class exceed those in the former. The following cases are instances: Cabot[2] reports a case in which the normal kidney excreted 36 per cent of phthalein in an hour. Its diseased fellow kidney was removed and the patient died of renal insufficiency. The kidney that failed was normal and hypertrophied. Asakura[3] in 70 nephrectomies had four operative deaths, one of which was due to anuria. According to indigo-carmine excretion and the cystoscopy, the kidney that failed was considered to be normal in function. Some years ago, before the days of phthalein, I saw a case that could not be cystoscoped because of an irritable urethra. Anephrotomy on one side and decapsulation on the other was performed. The operation was unduly long. Neither kidney showed any gross abnormality. The patient died anuric, yet neither kidney was removed and operations which are often done for the very relief of anuria had been performed.

I believe that neither the progressively decreasing output of phthalein suggested by Geraghty, nor any other known test, will give any index to the occurrence of these cases. A modified reverse of Beer's and Alessandri's conclusions as to the value of phloridzin "that, while it is of value when positive, it is of no value when negative," can be said of all renal tests, and especially of phthalein. That is: *Positive and sufficient phthalein excretion does not preclude the possibility of death from renal failure.*

There are four other points which I wish briefly to consider in estimating renal function:

[2] "Phenol. as a Test of Renal Function." Tr. Am. Ass. Genito-Urin. Surgs.

[3] "Über die Nieren Tuberkulose," Deutsche Gesellschaft f. Urol., Sept., 1911.

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1913.

*First, variations of phthalein in normal cases.* In 25 cases (nearly all intravenous phthalein) the average time of collection of phthalein after its appearance was about 15 minutes. In almost one half of these cases the time of collection was but 5 minutes. Some variations of excretion are due to this short period of collection. I believe, however, that if urine runs from either catheter freely, a diagnosis can be made in most cases in such a short period. If there is one thing more than any other which has brought cystoscopy into disrepute it is the old-time, nerve-racking sessions. Slight inaccuracies of diagnosis are better than leaving the impression that cystoscopy is a major operation. Likewise with very rare exceptions cystoscopy should be a "one-step procedure."

In these 25 cases, which, from the phthalein and urea excretion, the microscopical, and other examinations, I have every reason to believe were normal, the shortest time of appearance of red after intravenous injection was three minutes, the longest 12 minutes. The greatest variations in the excretion of the two were in proportion of 2 to 1, on one side an excretion of 10 and the other 21 per cent.

As a fair guide to normal excretion after intravenous injection, Keyes gives the terse formula, "1 per cent in 1 minute for 1 kidney." In one of my cases 30 per cent was excreted in 8 minutes. The lowest excretion was 10 per cent in 15 minutes. In one ureter catheterism case in which the urine flowed freely there was no red excreted for 20 minutes after an intramuscular injection. In line with this instrumental inhibition I have seen a case of bilateral nephritis with one kidney as good as the other in which for a half hour no urine at all came from one kidney, while urine dropped constantly from its fellow. In most cases after intramuscular and intravenous injection the greater part of phthalein comes down in the first hour. In entirely normal cases this may be reversed. In a case of unilateral kidney bleeding due to hæmophilia, 9½ per cent came down in the first hour and 46½ per cent in the second. The ratio of red excretion in a given time, respectively after intravenous and intramuscular injection, is usually about 2 to 1.

*Second, the individual "dead line."* Every death from suppression of urine following a nephrectomy is said to be due to the inability of the remaining kidney to sustain life. The immediate cause of death in such a case is the operation, the anæsthetic, the surgeon's manipulations, or both. Because of the varying technical skill of different surgeons, any general measure of functional capacity must be modified to accord with the surgeon that is to operate. In other words, if the one surgeon places his "dead line" at a certain percentage of excretion this "dead line" may not at all apply to a second surgeon whose mode of operation may vary considerably from that of the first. To establish such a personal "dead line," such a low limit of excretion of either normal or introduced substances, one must have had at least one patient die of renal insufficiency. This death will establish a low limit of excretion which if approached in any other case will preclude nephrectomy. It is possible that the low limit of excretion of both kidneys, as observed in cases of prostatectomy, might apply to a single kidney in cases in which nephrectomy is the operation.

In 50 normal and abnormal kidney cases in which phthalein was used I have learned nothing of the renal function and of the practical value of phthalein in estimating the renal function. In none of these cases was there enough disease to seriously impair the function of the remaining kidney. In other words, in the 50 consecutive cases one kidney never varied seriously from normal function. This indicates how difficult it is to get enough cases upon which to base any deductions as to the value of any renal function tests.

*Third, urea and phthalein.* The estimate of the urea percentage and the urea volume (the latter is of more value) is a necessary and valuable adjunct to the information given by phthalein, not so much to tell us of renal function, for the urea excretion from one kidney tells us nothing of its function, but as an aid to diagnosis.

*Fourth, value of estimating the total destruction of the kidney.* Five years ago in speaking of the urea excretion I said that with the total urea excretion from the diseased kid-

ney less than one-fourth of that excreted by its fellow, such a kidney is practically destroyed. This estimation was arrived at by examining the reports of a number of cases in which nephrectomy had been done. The value of this seems to be twofold: First, it is of worth to know if a kidney is practically useless, and has practically very little or no tissue left—because then a surgeon will have less compunction about removing it if the diagnosis of the cause of the disease is in question. Second, it would seem if one kidney were entirely destroyed and if the other kidney had taken up the total excretory work, had hypertrophied, this case would be less likely to be one of the class of "sports" spoken of above. This class of cases should be furthest removed from the possibility of death from renal failure. In making this 4 to 1 equation, either urea percentage, urea volume, or phthalein may be used. I believe, however, that the urea volume gives more accurate results than either of the others.

SUMMARY

Phthalein is the best single drug for the estimation of the kidney function. The amount of phthalein excreted varies with the destruction of kidney tissue and generally, but not always, with the functional capacity of the kidneys. Because of the variations in its excretion phthalein should be used in conjunction with the urea excretion, not to estimate the kidney function directly, but to estimate the comparative work of the two kidneys. If the urea volume of the diseased kidney is less than one-fourth of that excreted by its fellow, that kidney is practically destroyed. In certain cases no known test of renal function can foretell the death from anuria that follows operation.

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# AN OVARIAN PREGNANCY LOCATED IN THE GRAAFIAN FOLLICLE[1]

By FRANKLIN P. MALL, M. D., Baltimore
AND
ERNEST K. CULLEN, M. B., Detroit
From the Anatomical Laboratory of Johns Hopkins University

THE following unusual specimen is reported because it is not only of interest to the surgeon, but also to the embryologist. The diagnosis was difficult on account of the misleading statements of the patient. It is of great scientific value, for the specimen shows conclusively that the ovum had lodged itself in the Graafian follicle, undoubtedly in the one from which it came, indicating that the sperm must have entered the follicle after it had ruptured. The fertilized ovum then found lodgment in the follicle, around which the corpus luteum developed. As in other cases which have been reported, no decidua was formed, showing that the decidua is not of embryonic origin.

The specimen illustrates well the advantage of co-operation in research. Under a different organization with a properly equipped laboratory attached to a surgical clinic, specimens of great scientific value may be recognized and properly reported, but it is not necessary to have an entire medical faculty attached to each clinical laboratory in order to make progress in medical-biological science.[2]

This specimen has passed through a number of hands, and in part this publication rests upon the following original records:

No. 26035, Surgery, Johns Hopkins Hospital.

No. 15085, Gynecological-Pathology, Johns Hopkins Hospital.

[2] The publication of a similar specimen by Bryce, Teacher, and Kerr (Contributions to the study of the early development of the embedding of the human ovum, aided by the Carnegie Trust of the Scottish Universities, Glasgow, 1908) shows a similar co-operation. Here three experts, the embryologist, the pathologist, and the obstetrician joined to describe an early ovarian pregnancy.

[1] With the aid of the "Foundation in Art as Applied to Medicine," Johns Hopkins University, and the Carnegie Institution, Washington, D. C.

No. 550, Embryological Collection, Johns Hopkins University.

Surgical patient No. 26035, age twenty-four years, was admitted to the Johns Hopkins Hospital June 1, 1910, with the diagnosis of appendicitis, and was operated upon by Dr. Finney, June 3, 1910.

The clinical history, taken on June 1st, is as follows: When admitted to the ward the patient was not complaining of acute pain, but only of general soreness in the abdomen. There were paroxysms of pain, general throughout the abdomen, with intermissions in which she was somewhat more comfortable. With difficulty the pain was localized in both the left and right sides of the abdomen.

When examined by Dr. Finney, general soreness of abdomen was found, the pain being more acute along the left side, shooting up to the right shoulder. The pain had not changed in character or intensity. There were sharp attacks of pain especially in the left side when the patient tried to move. There was also difficulty in breathing.

During the afternoon the condition of the patient was very uncomfortable with repetitions of the symptoms just given. The pains became more acute after taking ice. A renewed onset occurred at 11 P. M., and this continued with some nausea and occasional vomiting.

The pain had been sharp (not crampy), and had apparently gone up under the right C. M. in the morning. There had been pain also under the shoulder. The patient said she had never had any similar previous attack, and was not constipated previous to this one.

June 3d the patient said she had a similar attack of abdominal pain three years ago. This was general at first and finally became more pronounced on the right side, accompanied by nausea and vomiting. From this attack she did not recover entirely for ten days. She had a similar but milder attack several months later.

Dr. Finney writes: "When I saw the patient, I did not think it was appendicitis, but the history of similar attacks, which I had reason to believe afterwards were fictitious, and the patient's misstatements as to the subjective signs together with the fact that the patient was unmarried, misled us as to the true diagnosis. Upon opening the abdomen, however, it was found to be filled with blood. At once the diagnosis was clear. I looked for the tubes, but found both intact. The right ovary was the point of bleeding; it was swollen and appeared as you found it in the specimen. The whole process was so definitely confined to the ovary that it seemed, clinically, to be a definite case of ovarian pregnancy."

The patient made a speedy recovery and was discharged on June 20th.

The specimen was sent to the Gynecological-Pathological Laboratory to be examined, and the following record was made:

The specimen consists of a tube and ovary from the right side. The tube at its outer extremity has been considerably mutilated. The portion received measures six centimeters in length and is somewhat tortuous. It shows a few adhesions on the surface. Section through the middle portion of the tube shows the mucosa to be somewhat thickened and blood-tinged. Section through the distal portion gives a similar picture. There is no gross evidence of an extra-uterine pregnancy. There is a portion of the fimbria present, but the portion of the tube between this and the middle is missing. There is nothing to suggest placental tissue. The mucosa appears normal in the sections.

The ovary measures 5 x 4 x 3½ centimeters. The surface shows a few old adhesions. On section the ovary shows a cyst three centimeters in diameter. Clinging to the wall and bulging into the cavity is a blood clot two centimeters in width and eight millimeters in thickness. This on section appears to be a corpus luteum. It is intimately connected with the walls of the cystic space. Further sections show villi in the clot attached to inner surface of the space in the ovary. The appearance of the specimen with a section through the ovary is shown beautifully (Figs. 1 and 2).

When the specimen was added to the embryological collection in the Anatomical Laboratory, there came with it several sections from the Gynecological-Pathological Laboratory and two drawings (Figs. 1 and 2) by Professor Brödel. These sections included the chorion, ovary, and uterine tube. The sections of the uterine tube appear normal with a very extensive infolding of mucous membrane and occasional lymph-nodules within it. Doubtless the sections are from the distal or fimbriated end of the tube. The sections from the chorion are apparently at right angles to its main wall as shown in the figure.

The villi, which are irregular in arrangement, show attachment to the main wall of the chorion, while at their distal ends they invariably butt up against the blood clot (Fig. 6). In no instance is there any sign of the decidua, nor do the sections containing the

villi contain any portion of the adjacent ovarian tissue. The blood clot is well organized with strands of fibrin extending in all directions and without distinct red blood corpucles. Most of the villi have a fibrous mesenchyme; in some it is mucoid. Scattered through the mesenchyme of the chorion there are blood islands or rather groups of blood cells within the blood vessels from the embryo. They are especially numerous where the villi are attached to the main wall of the chorion, showing that in its development the embryo must have been present at an earlier stage. The distal ends of the villi are apparently covered with a double layer of epithelial cells, which is as should be in normal development; however, a rich peripheral trophoblast is missing. In the trophoblast there are numerous small masses of disintegrating cells. These appear to be pretty well intermingled with mesenchyme cells at the tips of the villi as shown in the figure. Many polymorphonuclear leucocytes are present where the trophoblast comes in contact with the blood clot. Among the leucocytes there are isolated cells of the trophoblasts. At points the isolated cells are also embedded in the mesenchyme of the villi. Altogether these processes are quite identical with those found in the villi of the uterine moles, where there is also every indication of degeneration of the villi and their trophoblast due to either faulty implantation or to infection. In none of the sections is there any indication of the embryonic mass, nor do the sections which were sent show the character of the ovarian tissue adjacent to the clot containing the villi, although in a number of sections the chorionic wall is shown to be composed of two layers which doubtless represent both the chorion and the amnion (Fig. 6, *Am* and *Ch*). In one section these two layers are blended for a short distance, and at this point there are numerous embryonic blood vessels. The fact that the amnion, which is quite characteristic, is in close apposition with the chorion, and the presence of numerous blood islands, show quite conclusively that they are identical with an ovum which is sufficiently well advanced in development to contain an embryo about 15 mm. long.

When the specimen came to us, it was composed of two pieces which were formed by cutting directly into the side of the rupture as shown in Figs. 1 and 2. These are drawn natural size, and therefore give the dimensions of the ovary. A loose piece of clot was taken out and cut in serial sections, but upon close examination with a microscope no trace of the chorion could be found in any of them, so it appears as if we had received only the clot and a small remnant of the chorion attached to it, which had possibly invaded the ovarian tissue and lodged itself freely within it. The ovary was then cut into slabs about 5 mm. thick, and at a distance from the cavity containing the villi a large corpus luteum, 10 mm. in diameter, entirely filled with blood, came into view (Fig. 3). New sections of the wall of the cavity were then made, which show that the cavity as a whole is lined with a smooth grayish membrane barely one half of a millimeter in thickness. In the tissue between the corpus luteum and the main wall of the cavity there is an extravasation of blood which enters a few of the adjacent Graafian follicles. The arrangement of these follicles is well shown in Fig. 2, but the corpus luteum, which is filled with blood, is much nearer the proximate pole of the ovary, and is therefore not shown in this section. It is close to the point marked "*Adh*" (Fig. 1). Sections were then cut through the whole ovary including the corpus luteum and the blood clot to which the villi are attached. These sections include all of the structures of the ovary, and give the entire wall of the cavity containing the ovum. The sections, showing most of the structures, are at right angles to the ovary directly through the "O" of the word "Ovary" (Fig. 1). These sections were stained in a great variety of ways: hæmatoxylin, acid funchsin, iron hæmatoxylin, eosin and aurantia, Ehrlich's hæmatoxylin, orange G., and a number of connective tissue stains. In general, they show that the ovary is active and not fibrous, apparently normal, containing numerous blood vessels, and a ring of large Graafian vesicles (Figs. 2 and 3) with an outside zone of small vesicles containing small ova. To all appearances this is as it should be in a young individual.

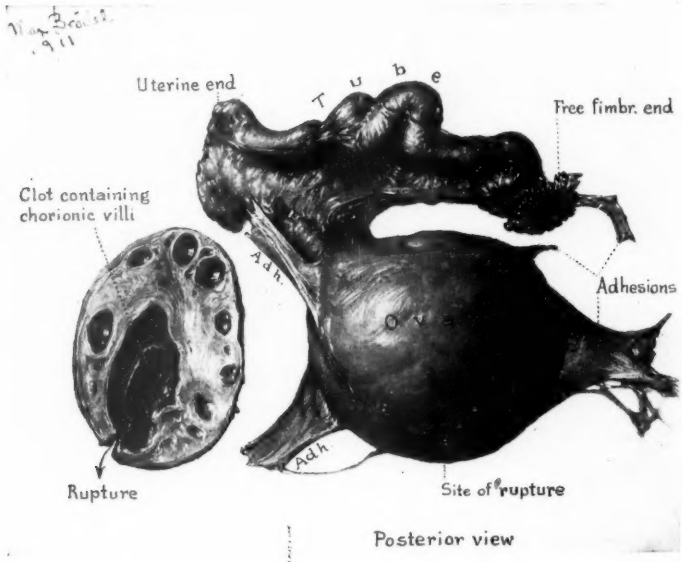


Fig. 1. Posterior view of the ovary and uterine tube before it was cut open. *Adh*, adhesions. Reduced one-tenth.

Fig. 2. Transverse section through the ovary at the point of rupture of the follicle from which an extensive hæmorrhage took place in life. The clot is covered with an inverted chorion and contains villi. Reduced one-tenth.

The wall of the cavity, containing the blood clot and villi, is lined almost throughout with a layer of lutein cells (Fig. 5). This layer is quite uniform, ranging from one half to one millimeter in thickness. Between the lutein cells there are numerous strands of blood vessels, but on their inner side there is a layer of fibrin before the blood clot begins. On the outside, the lutein cells form small islands of more compact cells that stain more intensely in hæmatoxylin (Fig. 5, *Cl'*). The section reminds one very much of a section of the adrenal. We have here a layer of lutein cells well spread out, possibly due to the distention of its cavity by the ovum and representing the corpus luteum, which, according to our conventions, is about as old as this ovum appears to be. In other words, it is clear that the ovum developed within the cavity of the Graafian vesicle to which it belongs. The corpus luteum, filled with blood, near the proximate pole of the ovary (Fig. 4), which at first sight appears to represent the one from which the ovum came, is considerably more advanced in development than the one containing the ovum; therefore it belongs, in all probability, to a previous ovulation. Had it not been for the additional sets of sections we made, it would have been necessary to interpret this specimen as Bryce, Kerr, and Teacher did theirs. The hæmorrhage in the ovary between the older corpus luteum and the cavity containing the ovum could easily be viewed to indicate that the ovum invaded the ovarian tissue as shown by the illustrations of these authors.

The older corpus luteum demonstrates once more very clearly that it is imperative to standardize the development of the corpus luteum anew. It is encircled by a very marked corpus fibrosum, which is wavy and forms a uniform sheet about one half millimeter in thickness beyond the blood clot (Figs. 3 and 4). There are few lutein cells within it. On the inner side of the corpus fibrosum, there is a thick layer of degenerated blood, and in the center there is a large mass of well defined red blood corpuscles. Within

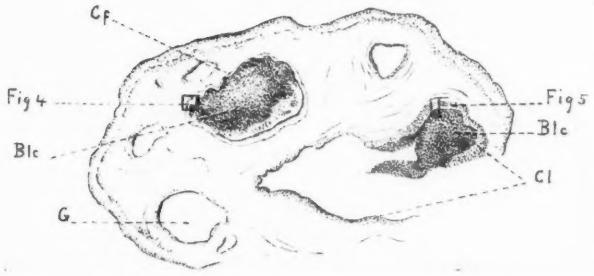


Fig. 3. Outline of a transverse section through the "O" in "Ovary" of Fig. 1, showing the clot containing the ovum surrounded with a layer of lutein cells and the adjacent corpus fibrosum. Enlarged nearly two diameters. *Cl*, layer of lutein cells; *Blc*, blood clot; *Cf*, corpus fibrosum; *G*, Graafian follicle.

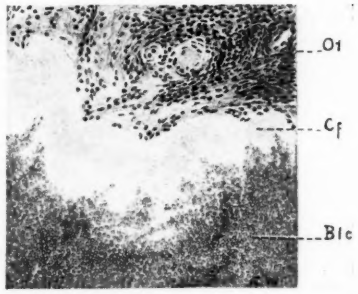


Fig. 4. The small square of the wall of the corpus fibrosum marked in Fig. 3, enlarged seventy diameters. *Cf*, corpus fibrosum; *Blc*, blood clot; *Ot*, tissue of the ovary.

the very center of the clot, there is a cleft which is curiously lined and filled with red corpuscles, staining somewhat differently from those of the rest of the clot. Also at the periphery of this clot there is a curious vesicle, lying immediately under the outer fibrous layer, which may indicate a more recent hæmorrhage. At any rate the lutein cells encircling the cavity containing the clot and ovum prove quite conclusively that the ovum did not wander from a distant Graafian vesicle and become implanted freely within the tissue of the ovary. This conclusion has also been

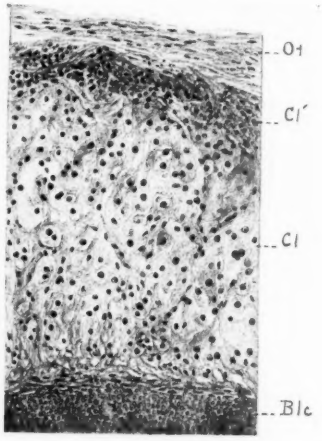


Fig. 5. The small square marked "Fig. 5" in Fig. 3 enlarged seventy diameters. Typical lutein cells are shown which form two layers marked *Cl* and *Cl'*; *Ot*, tissue of the ovary; *Blc*, blood clot within the corpus fibrosum.

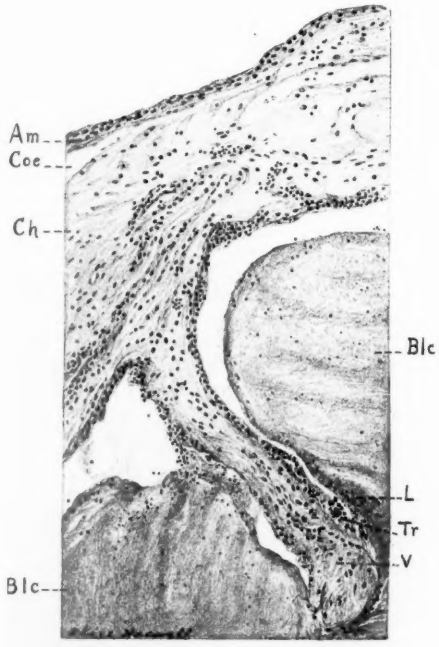


Fig. 6. Section through the free surface of the clot of Fig. 1, showing the wall of the chorion with a villus imbedded in the blood clot, *Blc*. The trophoblast, *Tr*, is scanty and is intermingled with leucocytes, *L*, which are also scattered throughout the blood clot. The mesoderm of the chorion, *Ch*, and villus, *V*, are fibrous. In this portion of the section the amnion, *Am*, is blended with the chorion, but on the left side a cleft, the cœlom, *Cœ*, (x 50) extends throughout most of the section.

reached by Serebrenikowa [1] in a recent report of a case of ovarian pregnancy, which confirms fully that of Van Tussenbroek.

Bryce, Kerr, and Teacher have recently given an excellent review of the literature on ovarian pregnancy, so it is not necessary to repeat it. From another standpoint the subject has been presented by Serebrenikowa. Both of the papers demonstrate that in ovarian pregnancy no decidua is formed, showing that the decidua is not of embryonic origin and that it cannot arise from the tissues of the ovary.

Since the cavity containing the ovum in ovarian pregnancy does not always seem to be encircled by a layer of lutein cells, it is concluded that the ovum either invaded the ovary from its surface or that it burrowed from the Graafian vesicle after fertilization. Undoubtedly the second is the case in the specimen recorded by Bryce, Kerr, and Teacher. In it the growing ovum broke through the layer of lutein cells and made for itself a cavity in the vascular stroma of the ovary. This conclusion could also have been drawn from our specimen had not a second set of sections been made which show that a beautiful and characteristic layer of lutein cells is present. In the first set of sections the wall of the cavity was faulty, while the second was perfect. We do not wish to question the accuracy of other observers in this respect; we only want to record our own experience. At any rate the possibility of a secondary attachment of the ovum to the ovary through its direct wandering from the Graafian vesicle into the adjacent tissue, or indirectly through a reinvasion from the surface of the ovary, can not be denied until it is shown that the ovum is invariably lodged in a Graafian vesicle surrounded by a layer of lutein cells of the same age as that of the ovum. Before this is possible it will be necessary to standardize the corpus luteum in relation to the ovum and embryo, and also to present as evidence only well-preserved specimens of ovarian pregnancy.

[1] Serebrenikowa, Arch. f. Gynäk., 1912, xcviii.

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# MALIGNANT DISEASE OF THE TESTICLE RETAINED WITHIN THE ABDOMINAL CAVITY

By KENNETH BULKLEY, M. D., New York City
From the Laboratory of Surgical Pathology, Department of Surgery, Columbia University

As far as I have been able to determine there has never been in the English language a collective study of the literature on the subject of malignant tumors of testicles situated within the abdominal cavity. The most recent collection, which I have been able to find on the subject, was made in France, in 1906, by Blanck (7) who collected from the literature 18 cases and added one case of his own, making a total of 19 cases. The material on which this paper is based consists of 57 cases collected from the literature and two additional cases hitherto unreported, one of them coming under the writer's personal observation. As the majority of these cases have been reported in the foreign literature, I have made brief synopses of them which will be found at the end of this paper.

The two new cases which I wish to report are as follows:

Case 1 (History No. 10987, First Surg. Div.). Male, age 42. Patient was admitted to the Presbyterian Hospital, January 9, 1911, with the history that about a month previously he had first noted a mass in the left lower abdomen. This mass had not at any time been painful nor had it apparently increased in size since first noticed. There was no history of trauma. His general health has otherwise been good, except that for many years he has been moderately constipated and has had more or less indigestion. Patient has been married for many years but though both he and his wife have desired offspring there has never at any time been a sign of pregnancy. The patient has never been examined for the presence of spermatozoa. His wife has been

Fig. 1. Photograph of the gross tumor in author's Case 1 showing smooth lobulated character, and general contour. The scale reads in centimeters.

examined repeatedly and pronounced normal. As far as the patient knows, none of his forebears have had a congenital defect such as harelip, hypospadias, etc.

Examination showed a man of medium build, well developed muscularly, nothing in bony framework, facies, or voice suggesting the feminine. In the left lower abdomen beneath the rectus was felt a mass, smooth, rounded, slightly movable, hard, not tender, apparently about the size of a fist. Abdomen was otherwise normal. Penis normal, no hypospadias. Scrotum was present but small and showed the usual median skin raphe. No testicle was felt in either side of scrotum nor in inguinal canals. Inguinal lymph nodes were not enlarged. No other associated congenital deformities found.

Operation was performed January 10, 1911, by Dr. Joseph A. Blake. A six-inch vertical incision having its center a little below the umbilicus and splitting the left rectus muscle was made, and deepened, opening the peritoneal cavity. Immediately there presented a grayish, pearly white, glistening tumor, covered with peritoneum and lying behind the bladder to which it was adherent. The tumor mass was adherent, by a pedicle about three quarters of an inch in diameter, to the region of the internal ring of the left inguinal canal. The length of the pedicle was about two and one half inches. Posterior to the tumor lay the coils of small intestines. Running from the posterior surface of the tumor toward the base of the bladder was the vas deferens. This was divided, the tumor mass was separated from the bladder wall, the pedicle was divided, and an attempt was then made to free the tumor from the small intestine. The union between the two was so firm that this was found impossible and accordingly a five-inch intestinal resection with end-to-end suture was done and the mass removed. The abdomen was partially closed about a gauze and rubber tissue drain. The right testicle was not seen during operation.

Except for a slight wound infection, the immediate post-operative convalescence was uneventful. About two years after operation the patient went through a severe typhoid fever successfully and without hæmorrhage. At the present time, two years and eight months after operation, he is perfectly well without sign of recurrence. For some months after operation the right testicle at times slipped into the internal ring, for the patient would feel a dull, sickening, testicular pain and a mass in the upper part of the canal. This he would reduce by pressure, thus relieving the pain. As he has become stronger since operation, this symptom has not troubled him so frequently.

The second case which I report was under the care of the late Dr. McCosh at the Presbyterian Hospital. So far as I can find, it has not been before reported and I now publish it by permission of Dr. Blake.

CASE 2 (History 2152, First Surg. Div. Presbyterian Hospital). The patient was a male, aged 42, whose chief complaint was pain on defecation. This symptom had been present for twenty years, but had been very much worse for the past ten years. Constipation has been marked, bowels moving only at intervals of three to four days. Recently he has noticed that the movements are in the form of hard, scybalous mass. No melæna.

Examination showed a poorly nourished man. Left testicle in scrotum and apparently normal. Right testicle absent from scrotum and inguinal region. To the right of the median line in the lower abdomen is felt a large, hard mass.

Exploratory laparotomy by Dr. McCosh showed a large mass adherent to the abdominal wall, rectum, bladder, and omentum, and completely filling the pelvis. It was considered inoperable and the abdomen was closed. Patient discharged unimproved, and further history is unknown. Though no sections were taken of this tumor, it was considered and classified as a sarcoma. In the absence of microscopic section I have classified it under the indeterminate name of "cancer."

## HISTORY

It has seemed to be for years a surgical superstition that the testicle retained within the abdominal cavity is prone to undergo malignant degeneration. Many of the older writers, Dupuytren (22), Arnot (2), Gowers (30), Lecompte (41), Godard (29), Spry (75), mention this possibility, all of these writers calling attention to it before Johnson (32) in 1859 put the first case on record.

Godard (29), however, had apparently observed cases before this date, for he states that in eight monorchids of which he has records, all having sarcoma, seven had sarcoma of the undescended testicle and the eighth a sarcoma of the scrotal testicle. This author does not, however, report these cases.

Since Johnson reported his cases, a number of German and French writers have collected series of cases and placed them on record. The literature on the subject is remarkably scarce. Among the papers which should be particularly mentioned are those of Maydl (51), Farwick (26), Eigenbrodt (24), Meiser (53), Kaeppelin (34), Rademacher (65), Szymanowski (78), Chevassu (13), and Blanck (7). The majority of papers other than these contain merely case reports.

That the condition is a surgical rarity will be admitted by all. Bland-Sutton (8), in 1910, could find in the museums of the London Hospitals only 14 specimens of malignant undescended testes. He states, "In a few of these cases the testis was retained in the abdomen but in most instances it had entered the inguinal canal."

Kaeppelin (34) says that many of the best known French surgeons have never observed a single case. I can find no cases reported before 1859 and since then have found only 57 in the medical literature of France, Germany, Russia, Italy, and the English speaking races. Various statistics are at hand showing the frequency of the condition relative to that of cryptorchidism, associated inguinal hernia, malignant testicular tumors in the inguinal canal, and malignant scrotal testicles. Marshall (48) examined 10,800 conscripts and found 1 double cryptorchid, 6 left cryptorchids, and 5 right cryptorchids. Monod and Terillon (54) found six ectopic testes among 3,600 conscripts. These statistics are probably not reliable as many men knowing of their deformity might not apply for the army. Eccles (23) found among 60,000 male admissions to a general London hospital 38 cases of sarcoma testis. Of these only one was imperfectly descended and that was a left abdominal sarcomatous cryptorchid. Howard (31) found that among 110,000 male patients admitted to a number of the London

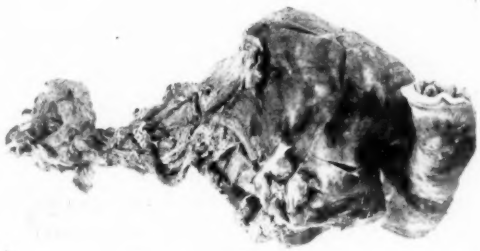

Fig. 2. Photograph of reverse side of tumor shown in Fig. 1. At upper portion is seen the resected gut. The prolongation below contains the vas deferens and a mass of fibrous tissue in which are found the remains of the pampiniform plexus.

Hospitals during a period of 20 years, there were 65 cases of malignant testicular disease, or about .06 per cent of all male patients admitted. Of 57 cases with complete histories, 9 were in ectopic testicles, 8 of these being in the inguinal canal and 1 just below the external ring. I have looked over the records of 12,729 consecutive male admissions to the Presbyterian Hospital and have found 13 malignant testicular tumors. Of these, 11 were situated in the scrotum and two within the abdomen. Thus in 182,729 male admissions to general hospitals there were three cases of malignant growths of intra-abdominal testicles, or about one in each 60,000 cases.

Eccles (23) reports that of 48,000 males with hernias, 854 had imperfect descent of one or both testes, and that none showed any malignant disease. Coley (15) reports that of 49,859 males with hernias, 400 had imperfect descent of one or more testes. No mention is made of malignancy. Thus in 97,859 male hernias there were 1,254 cases of imperfect descent of one or more testes, or about 1 to 77. None of these are reported as malignant.

Shoedel (quoted by Kaeppelin) encountered 5 cases of cancer of the inguinal testicle as against 36 cases of cancer of the normally placed organ; Odiorne and Simmons (57) reviewed 54 cases of malignant testicular disease from the Massachusetts General Hospital and found that 6, or 11 per cent, were in undescended testes. Of these, four were in the abdominal cavity and two in the

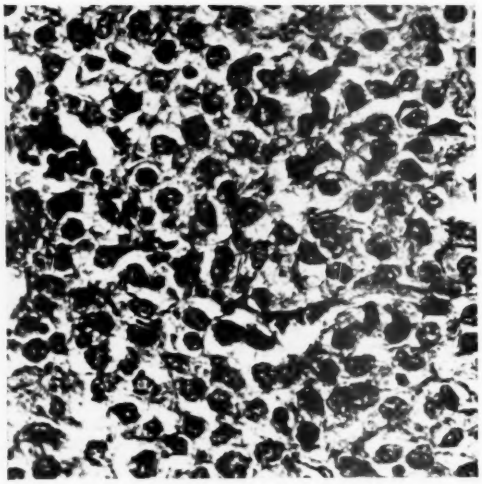

Fig. 3. (x 450) Microphotograph author's Case 1, showing an area of the tumor composed chiefly of large polygonal or round cells, apparently a pure carcinoma.

inguinal canal. Chevassu (13) encountered 10 malignant inguinal as against five malignant abdominal testes. Rademacher (65), on the other hand, gives the proportion of malignant abdominal to malignant inguinal testicle, as 1 to 8. Meiser (53) in 1898 collected 64 malignant inguinal as against four abdominal testes. Blanck (7) in 1906 was able to collect 19 cases of abdominal and 93 cases of malignant inguinal testes. My statistics from the Presbyterian Hospital show 2 cases of malignant abdominal and no cases of malignant inguinal testes. Summing up these records we find a proportion of about 1 in 4 cases of malignant disease of the ectopic testicle in which the testicle is situated within the abdominal cavity.

And finally, as to the relative frequency of the condition under discussion to that of scrotal malignant testicular tumors, Chevassu (13) encountered 113 scrotal to 5 abdominal tumors, Odiorne and Simmons (57) found 48 scrotal to 4 abdominal, and my records from the Presbyterian Hospital show 11 malignant scrotal to 2 malignant abdominal testicular tumors. An analysis of these three reports gives the relative frequency of the two conditions as about 1 to 15.

ETIOLOGY

It is not the purpose of this paper to discuss the etiology of the non-descent or mal-descent of the testicle, but it may be of interest to briefly note a few facts in regard to this phenomenon.

The genital gland lies at first to the mesial side of and just below the lower pole of the kidney. At the end of the third month the testicle lies in the false pelvis, and by the end of the sixth month close to the abdominal wall at the inguinal ring. The descent from here on is variable. Wrisberg[1] examined 102 male fœtuses at term and found 72 had both testicles in the scrotum. In 4 the testicle was in the abdomen. Five had double inguinal testes. Three had one testicle in the abdomen and the other testicle in the inguinal canal. Eighteen were monorchids. Of these there were 5 abdominal and 18 inguinal testicles. It is probable that the majority of these testes would have reached their normal position in the scrotum some time between birth and puberty.

The cause of non-descent has long been a mooted question. The best paper on the subject has probably been written by Eccles

[1] Quoted by Godard (29).

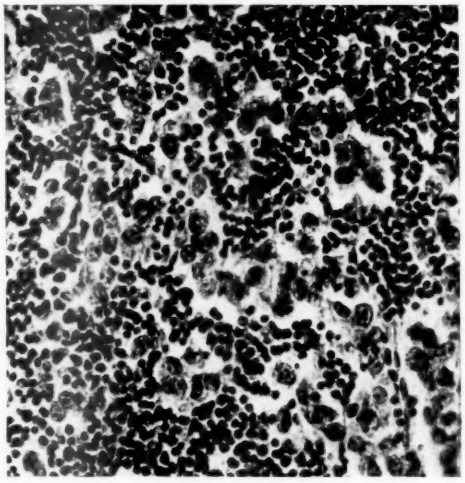

Fig. 4. (x 290) Author's Case 1. Portion of tumor showing much lymphoid stroma. In other regions of the tumor these cells are so disposed as to strongly suggest a small sarcoma.

(23) who classifies the causes of arrest as follows:

1. Conditions associated with the mesorchium.

(*a*) Mesorchium too long so that testicle hangs too freely in the abdomen and would thus be prevented from engaging in ostium of the processus vaginalis.

(*b*) Adhesions between the peritoneum forming the mesorchium and the adjacent portions of the serous membrane, generally the result of intra-uterine appendicitis.

(*c*) Abnormal persistence of the plica vascularis.

2. Conditions associated with the testicle and its component parts.

(*a*) Vas deferens may be too short.

(*b*) Spermatic vessels may be too short.

(*c*) Epididymis may be abnormal in size.

(*d*) Fusion of the two testes (synorchism).

(*e*) Certain forms of hermaphroditism.

3. Conditions associated with the gubernaculum testis.

(*a*) Absence of the upper normal attachments of the gubernaculum.

(*b*) Deficiency of its muscular fibers.

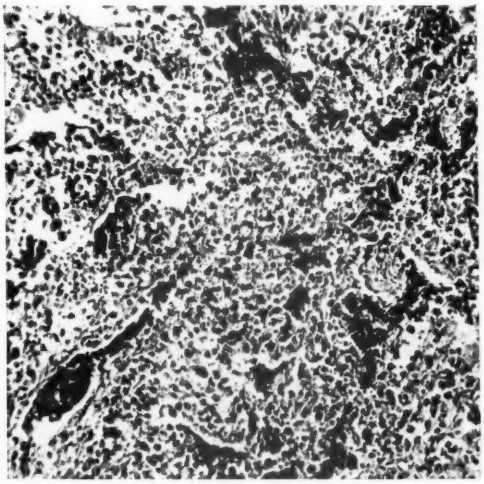

Fig. 5. (x 120) Author's Case 1. Low power photograph showing the arrangement of peculiar cells described in text. A number of attempts at high power photographs of these cells were made but owing to lack of sufficient detail they were found useless for publication.

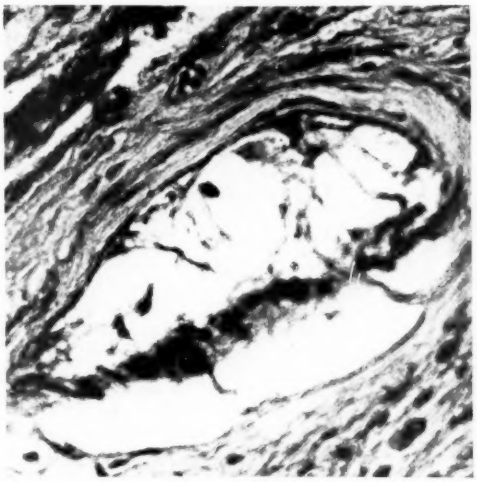

Fig. 6 (x 450) Author's Case 1. Photograph of portion of capsule of tumor showing œdematous connective tissue and atrophic and compressed tubules. No spermatozoa seen.

(*c*) Deficiency or absence of its scrotal attachments.

4. Conditions associated with the cremaster.

(*a*) Retraction of the testis after it has descended to its usual habitat in the scrotum.

(*b*) Want of action of the internal fibers of the cremaster, before the testicle has reached the inguinal canal.

5. Conditions associated with the route along which the testicle has to pass.

(*a*) Ill development of the inguinal canal.

(*b*) Ill development of the superficial abdominal ring.

(*c*) Ill development of half the scrotum.

6. Other conditions, such as the wearing of a truss, preventing the outward passing of the organ into the scrotum, etc.

Eccles goes on to state that the various abnormal positions of the testicle in man may be normal in other animals. Thus the testicle remains in the back of the abdomen near the kidneys in the snake, pigeon and frog. In the hedgehog it still lies in the abdomen but close to the inguinal ring, while in the hare it lies in the inguinal canal. In apes the processus vaginalis remains open. In the pig the testis normally lies in the peri-

neum. In marsupials the testes occupy a prepenial position. In some animals the position is not permanently scrotal, the organ descending during the mating period and being withdrawn into the abdomen or inguinal canal when the season is over. Eccles states, "It is a fact that the various pathological conditions associated with imperfect descent in the human subject are unknown, or almost unknown in those animals in which the testes never transgress the limits of the abdominal wall."

HEREDITY

Heredity seems to play an inconsequential rôle. Here and there are scattered cases giving a history of familial neoplasm or congenital defect, but in general such a history is not found. In one case (Marchand) a brother is said to have died of the same disease.

TRAUMA

I have encountered one case, Pederson (60), which might be called, for want of a better term, a traumatic cryptorchid. Fourteen years before coming under observation the left testicle of this patient was driven into the abdominal cavity by a blow from a baseball. Later this testicle became malignant. But trauma does not seem to be a very important factor. Only two cases of congenital cryptorchids give a history of direct trauma. In Johnson's (32) case the tumor and pain were first noted following a blow from a cricket ball. In Martin's (49) case a tumor mass appeared immediately after a blow on the abdomen, this mass not changing in size for two years, and then for a year increasing rapidly. Trauma from the contraction of the abdominal muscles may be a factor in those cases in which the testicle lies at or near the internal ring. It is conceivable and has been suggested that such a testicle may slip temporarily into the canal and suffer compression from muscle contraction. Certainly those testicles situated in the lumbar, iliac, or pelvic regions are well protected. Kaeppelin (34) believes that the danger of malignant degeneration is less in those testicles situated high in the abdomen. Theoretically, this view seems plausible, but a study of the collected cases does not substantiate it, and the traumatic view of the etiology of these tumors has but a small foundation.

Many authors, Odiorne and Simmons (57), Godard (29), Coley (16), Orth (58), believe or have suggested that the retained testis is more apt to undergo malignant degeneration than the normally situated organ. Cuneo and Lecene (17) think that the normally situated organ is more prone to become carcinomatous and the retained testicle sarcomatous. Bland-Sutton (8), on the other hand, is of the opinion that imperfection of an undescended testicle is the cause, not the result, of its failure to reach its goal in the scrotum. Kaeppelin (34) considers the abdominal retained organ relatively immune, arguing that if the malignant cases of abdominal, inguinal and scrotal testicles bore the same ratio to each other as the non-malignant cases, the malignant abdominal testis would be far more common than it is. Statistics already quoted confirm this opinion; for we found 1 cryptorchid in 900 men examined, and only 1 malignant cryptorchid in 60,000 men. We must conclude, therefore, that the abdominally situated testicle is relatively immune to malignant changes.

AGE

Of the 59 cases the age is not stated in 4. The ages varied from 17 to 52 years, the average age of 55 cases being about 34½ years. Forty-two, or a little over 75 per cent, occurred between the ages of 25 and 45 years. These figures correspond remarkably closely to those of Kober (39), who found that 71 per cent of 114 cases of scrotal sarcoma testis occurred between the ages of 20 and 50, and confirms the general opinion that practically all cases occur during the period of greatest sexual activity.

SIDE INVOLVED

Of 56 cases in which the side involved is stated, there were 30 right, 24 left, and 2 double. In 1 of the right-sided cases the left testicle was also involved but lay in the scrotum.

SEX

Fifty-five cases were in individuals evidently males. Four cases were in hermaphrodites. Two of these had passed as females and two

as males. Of the females, 1, Marion (47) had been married for 16 years, had no children, and had never menstruated. Vagina was present but laparotomy showed in addition to the tumor complete absence of either uterus or ovaries. The other case, Abel (1), had menstruated for eleven years. Cervix uteri was absent and vagina was small. The diagnosis of congenital vaginal atresia and hæmatometra was made and a pelvic section done. Patient died a few days later of spreading peritonitis and autopsy showed the mass felt to be a sarcomatous testis. One of the male cases, Primrose (64), showed no other congenital defect of the external genitals. No history of menstruation. Autopsy showed a well developed uterus and vagina and rudimentary Fallopian tubes. No vasa deferentia or seminal vesicles were found. The right testicle was sarcomatous. The other male case, Marchand (46), showed a well formed uterus and carcinoma of one of two abdominal testes.

PATHOLOGY

I have the anatomic material from only the first of my cases. In looking over the cases collected from the literature one is impressed with the variety of pathologic diagnoses given. In some of them, as in my second case, the diagnosis has not been confirmed by microscopic section, the case clinically and the pathology grossly being both fairly conclusive that the case was one of malignant disease of a retained testis. I have taken the liberty, as have previous writers on the subject, of including such cases in the series. The diagnoses given in the 59 cases are as follows:

| | |
|---|---|
| Sarcoma | 20 |
| Round cell sarcoma | 10 |
| Large cell sarcoma | 6 |
| Spindle cell sarcoma | 1 |
| Mixed sarcoma | 1 |
| Myxosarcoma | 1 |
| Cystic sarcoma | 1 |
| Teratoma | 2 |
| Epithelioma | 2 |
| Chorio-epithelioma | 2 |
| Carcinoma | 7 |
| Rhabdomyoma | 1 |
| Cancer | 5 |
| | 59 |

GROSS APPEARANCE

The tumors vary in size from a goose egg to masses filling the pelvis, or even the entire abdomen. The surface is smooth or grossly nodular, covered with peritoneum, glistening, and of a white or yellowish white color. Their situation is usually lateral, either occupying the iliac fossa or the pelvis, but they may lie at any point between the internal ring and the lower pole of the kidney. They may be fixed, having a sessible base, or mobile, with a long or short pedicle. This pedicle may find its attachment at any point between the lower pole of the kidney and the internal ring. It seems a rule that the higher positions of non-descent are less apt to be associated with pedicle formation than the low positions. The highest pedicle attachment which I have been able to find was at the sacro-iliac joint, while numerous cases are on record where the testicle was found adherent by a pedicle at or near the internal ring.

The point of origin has been determined in but few of them, but we can probably accept the statement of Ewing (25) that these tumors have their origin in the rete testis. The main tumor mass has invariably been testicular. The epididymis may or may not be invaded, but is usually not involved until a late stage. The majority of tumors have a definite capsule consisting of the stretched tunica vaginalis, and because of this capsule peritoneal implantation metastases are not common.

The tumor mass is usually adherent to some of the surrounding structures. Bladder, rectum, pelvic wall, ureters, kidneys, small intestine and its mesentery, anterior abdominal wall, omentum, and great abdominal blood vessels have all been found adherent to it. Pressure may distort or interfere with the function of some of these structures. Thus the rectum may be flattened against the sacrum, the great vessels may be pressed upon and made to deviate from their normal course, or the ureter may suffer pressure causing hydronephrosis.

There is apparently only a slight tendency to generalization through the organs of the body, but involvement of the lymphatic nodes occurs fairly early in the disease.

Malignant disease of the testis whether *apparently* sarcoma, carcinoma, teratoma, etc., spreads by the lymphatic rather than by the blood streams. The exception to this rule is seen in chorio-epithelioma, for in the two cases in the series of this type, Scott and Longcope (70), and Tirumurti (79), extensive distribution of metastases in the various organs of the body was found, and these are the only two cases in the series in which such metastases were found. Their occurrence in Scott and Longcope's case might have been due, however, to the fact that the tumor had ruptured into the inferior vena cava.

According to Most (55), the lymphatics from the testis drain first to the lumbar lymph nodes lying at about the level of the lower pole of the kidney. Those from the right testis lie on the vena cava and those from the left testis near the aorta. These nodes freely communicate by anastomosing channels, and they are the only barrier between the testis and the thoracic duct. Most was able to send an injection mass from the testicle to the entrance of the thoracic duct into the subclavian vein. They are not only the first lymph nodes but usually also the first areas in the body to be involved secondarily. Most considers them a very imperfect barrier and judging, as shown by Lesnès, (44) from the great frequency of reports of left subclavicular adenopathy in malignant disease of the scrotal and inguinal testicle, he seems to be correct. On the other hand it is interesting to note that of 59 cases of malignant abdominal testes I find but one case, Picqué (62), in which this adenopathy is mentioned. I am at a loss to explain this discrepancy in progressive metastasis between the malignant testicle situated within the abdomen and elsewhere.

The secondary lumbar involvement produces tumors of various sizes, firm, retroperitoneal, often larger than the original tumor, and frequently displacing if not actually adherent to or obstructing the aorta and vena cava. It is involvement of these nodes which has mainly been responsible for inoperability or recurrence.

All of the cases mentioning metastases of any sort have included also the retroperitoneal lymph nodes, especially those in the lumbar and pre-aortic region. Next in frequency comes what are apparently transplantation metastases on the peritoneal surface, mainly in the pelvis. Some of these extend high in the upper abdomen, one case showing metastases on the peritoneum covering the diaphragmatic surface of the liver and spleen and involving the capsules of these organs. Excluding the two cases of chorio-epithelioma, metastases have been noted in the following structures: psoas muscle 1, ureter 1, prostate 1, periosteum of vertebral column 1, spinal cord 1, urethra 1, kidney 2, bladder 2, liver 3. The two cases of chorio-epithelioma metastasized extensively. The structures involved were as follows: retroperitoneal lymph nodes, inferior vena cava, lungs, liver, myocardium, spleen, kidneys, stomach, intestines, pancreas and brain.

### MICROSCOPIC FINDINGS

All of these cases at autopsy or operation were well advanced and the point of origin has been determined in none of them. All have apparently been primary in the testicle with the exception of the cases of Silberberg (73) and Mathieu (50), in which the testicular growth may have been secondary to that of the kidney. Two thirds of them have been described as sarcomata of one form or another. The majority have been reported from a clinical rather than a pathological viewpoint, and, if extensive search for remnants of other embryonal structures has been made, it has not been so mentioned.

As no sections of my second case were taken, I can make no pathological report upon it.

The findings in my first case were as follows: The specimen is a spherical mass measuring 8 by 7.5 cm., weighing 210 grams. At the upper pole is attached a loop of excised small intestine 6 cm. in length. (Figs. 1 and 2.) Adherent to its lower and inner surface are fibers of muscular coat of bladder. Running along the lower and outer aspect and closely adherent to the surface of the mass is the vas deferens. On dissection the convoluted portions of the vas are seen to be continuous with the globus minor of the epididymis. Epididymis lies flattened over the surface of the mass a distance of 5 cm. Outer surface of actual tumor mass is free, smooth, and con-

tinuous with the peritoneal coat of the excised portion of small intestine. In this free surface are many much-dilated blood vessels.

The consistency of the tumor mass throughout is uniform. There are no areas suggesting in the gross either bone, cartilage, or structures of ectodermal origin such as hair or teeth.

Cut section through the center of the tumor mass presents homogeneous areas defined by exceedingly delicate striations continuous with one another and with the capsule, suggesting fibrous trabeculæ branching from a definite and well formed capsule enclosing the entire tumor. The thickness of the capsule varies from a few mm. to 1 cm.

### MICROSCOPIC SECTION

The outer layer of the capsule consists of fibrous connective tissue which in points is œdematous and shows numerous cross sections of flattened and atrophic testicular tubules in which no spermatozoa are found (Fig. 6). The tumor proper is composed of cells which are large, polygonal or round, and contain large, deeply staining nuclei. Numerous mitotic figures are seen. Connective tissue trabeculæ support a delicate reticular stroma. These trabeculæ divide the tumor into alveoli. Areas are found where a few cells are seen not separated by stroma, definitely suggesting epithelium. Here and there are areas in which these cells are separated by masses of mononuclear leucocytes. There are also seen areas in the tumor where the cells of all types are undergoing degeneration. In certain parts of the tumor are peculiar aggregations of cells which are narrow as if compressed. (Fig. 5.) These cells are elongated, darkly staining, and are arranged irregularly in whorls, as if filling in spaces between the alveoli. These cells with Mallory stain appear a faint blue, and suggest fibroblasts rather than any other type of cell. They are not of frequent occurrence, being found in only two or three of more than a dozen blocks of tissue taken from various parts of the tumor.

It is thus rather difficult to place this tumor under any classification other than that of a mixed tumor, for in addition to the difficulty of classifying these cells last mentioned, we have regions in the tumor in which the small round cells are so closely packed as to suggest a small, round-celled sarcoma, and other regions highly characteristic of an alveolar carcinoma. For these reasons we feel that the case should be classified as a mixed tumor or teratoma of the abdominal testis.

It is not the purpose of this paper to enter into a detailed discussion of the exact pathology of the cases which it collects. Indeed, it is impossible to do so, for the majority of cases have been reported from a clinical, rather than a pathological viewpoint, and accurate observations are lacking. Detailed studies have been made in only a few of them, so that it is not possible to state in how many of them there is absolute proof that the tumors have not shown more than one type of cell growth; in other words, that they are not tridermal.

Despite the various microscopic findings in the different cases there is a remarkable similarity in the clinical behavior and gross appearance of these neoplasma. From a study of these cases and the literature of testicular tumors, it becomes to the writer more and more evident that the conclusions reached by Ewing (25) that the majority of them are teratomata is correct. His monograph on the subject is so recent and comprehensive that the writer hesitates to again cover the ground, other than to quote his conclusions. With these we agree entirely and quote them as applicable to this series of cases. Among other conclusions reached by Ewing (25) are the following: "Chondroma, myxoma, lipoma, rhabdomyoma, and carcinoma have not been shown to exist apart from a teratomatous origin. Primary lymphosarcoma arises in the testicle but its exact cells of origin are as yet undetermined. It may first appear in the rete testis as do teratomata. Pure spindle-cell sarcoma probably arises in the testicle but is rare and its exact origin is uncertain.

"Alveolar, large round-cell, perivascular, and other forms of so-called sarcoma testis are of epithelial and teratomatous origin. Adenoma arising from the spermatic tubule cells is a rare tumor occurring in atrophic undescended testes.

"The commonest tumor of the testis is an embryonal carcinoma, alveolar or diffuse, with polyhedral or rounded cells and often with lymphoid stroma. These tumors are probably one-sided developments of teratomata."

SYMPTOMATOLOGY

The sudden onset of symptoms is exceptional, but acute abdominal pain coming spontaneously or following a blow or sudden exertion, may be the first symptom noted. It is probable in these cases that there has been a latent phase during which the tumor has been developing, and that some exertion or sudden change caused it to first make itself known. During this period the patient may experience vague and indefinite abdominal pain, dull, intermittent, and not associated with the taking of food, with defecation, or with urination. It is usually not the sickening pain of testicular pressure. It may be increased by or occur only during coitus. The pain is frequently lumbar rather than abdominal. In the course of a day to a few months, the patient notices an abdominal mass. All of the cases complain sooner or later of one or the other of these symptoms. Pain comes first, and mass second, in the list of symptoms first noted. The mass is usually lateral, lying in the iliac fossa, never median. It is usually not tender, but as it slowly increases in size, various functional disturbances appear and the general health declines. Abdominal tenderness was the first symptom noted in one case. Other symptoms first noted were constipation, four times; œdema of leg, three times; hæmaturia, once; pain in back, once; weakness, twice; nausea, once; painful defecation, twice. Of the secondary symptoms noted in addition to abdominal pain and mass may be mentioned the following: Symptoms referable to bladder pressure 6, constipation 4, loss of weight 5, anorexia 2, fever 1, neck tumor 1, œdema of leg 3, abdominal tenderness 2, sciatica 1, diarrhœa 2. Four of the cases were strangulated with twisted pedicles. These cases all had an acute onset with abdominal pain, fever, mass, nausea, vomiting, and objective signs of an acute abdominal lesion.

The majority of cases occur in individuals otherwise in good health. Cachexia occurs only during the later stages after involvement of other structures and interference with function. On examination one or both testes are found to be absent from the scrotum, perineum, or inguinal canal. Occasionally the abdominal mass can be felt only by rectum, but abdominal palpation usually reveals it. It is hard, lateral in position, beneath the parietes, usually but very slightly mobile, not tender, and dull to percussion. Percussion is usually tympanitic in the flanks, but rarely there may be some ascites, and dullness is obtained. Other secondary masses may be felt, or the entire abdomen may be completely filled with tumor mass. The inguinal glands are not enlarged. Enlarged glands at the root of the left side of the neck may be found. There is no rigidity without strangulation.

Various pressure symptoms occur. From ureter pressure a mass may be found in the flank, due to hydronephrosis. Œdema of the leg from venous or lymphatic pressure is fairly common. In one case a varicocele was found in the canal on the same side as the tumor. The fæces may, due to rectal pressure, be passed in small scybalous masses. The veins on the abdominal wall may be enlarged and their current reversed.

In nine cases the presence or absence of offspring is definitely noted. Five of these were fathers of children, but all five were single cryptorchids. Four cases had no children. Three of these were single cryptorchids, the fourth a double cryptorchid. There is thus not a single case of double cryptorchid with malignant testicle reported as having offspring. One case is noted as having erections only at long intervals, and as entirely lacking in sexual desire. One case complained of abdominal testicular pain during coitus.

DIAGNOSIS

The first element in the diagnosis is the establishment of the fact that one or both of the testes are not in the scrotum, perineum or inguinal canal. It is well nigh incomprehensible that in a number of the reported cases the absence of the testicle from its normal position was not noted until after death, but such is the fact.

In the early stages of the disease no abdominal mass may be palpable and the pain must be differentiated from that due to floating kidney, renal colic, appendicitis, pathologic lesions of the intestinal tract as tumors, ulcers, tuberculosis, etc., functional disease, parietal neuralgia, early Pott's disease, bladder pain, preataxic pains, etc.

When a tumor mass is appreciable the diagnosis can readily be made provided the non-descent of the testis is noted. It is unnecessary to enumerate the possible abdominal masses and their differential diagnoses, but again I wish to emphasize the necessity of routine examination of the external genitals in all cases of abdominal tumor, especially those in the lower abdomen.

While it is safe to say that the large majority of palpable and painful abdominal testes are malignant, the statement cannot be made without reservation. The mass felt may be testicular but not necessarily a *malignant* tumor of the testis.

Tuberculosis of the abdominal testis is exceedingly rare. Murphy states that no authentic case is on record. The only case I have been able to find is one reported by Roberts in 1828 and quoted by Godard (29). In this case there were found at autopsy a kidney, psoas muscle, and undescended testis "fused into a tuberculous mass." Among large collections of cases of tuberculosis testis reported, Keyes (38), Barney (5), et al., no cases of the disease in the abdominal testis are noted. No satisfactory explanation of the apparent immunity possessed by these misplaced organs has been offered.

Intra-abdominal orchitis is also exceedingly rare. Cantwell (12) records one secondary to appendicitis, while Descarpentiers (21) records a case following catheterization. Godard (29), Barnett (4), and Le Dentu (43) each report one case of abdominal orchitis probably gonorrhœal. These five are the only cases I have been able to find. No cases of syphilitic orchitis abdominalis have been reported. I have found no cases of abdominal orchitis following mumps.

Non-malignant tumors of the abdominal testis are practically unknown. Rothmann (67) in 1901 collected ten cases of hydrocele abdominalis with preformed sacs. I have been unable to find other reports either of the various cystic or solid non-malignant tumors commonly found in the scrotal testicle and epididymis.

Various associated congenital deformities may be found and so assist in the diagnosis. Of the 59 cases, 31 were single cryptorchids, 19 were double cryptorchids, 4 were hermaphrodites, and in 5 the exact condition is not stated. For the sake of brevity I have tabulated the abnormalities in these cases. They are, in addition to retention of the opposite testis just mentioned, as follows:

In 7 cases, inguinal hernia.
In 5 cases, hypospadias.
In 1 case, unusually small penis.
In 1 case, absence of erectile body of penis.
In 1 case, total absence of penis.
In 1 case, opposite testicle in inguinal canal.
In 1 case, cleft palate.
In 1 case, club foot.
In 1 case, horseshoe kidney with double ureter.
In 1 case, double kidney with double ureter.
In 1 case, angioma of liver.
In 1 case, clawlike deformity of hands and feet and absence of some of phalanges.

Associated deformities are thus seen to be fairly common. In addition to those which I have given, Eccles (23) mentions the following: Spina bifida, ectopia vesicæ, non-descent of the cæcum, double penis, and mammary hypertrophy.

The diagnosis before operation or autopsy of malignant abdominal testis in the female hermaphrodite has not as yet been made. The possibility of the condition should, however, be kept in mind, particularly in dealing with women who are sterile and show other evident congenital abnormality.

## PROGNOSIS

In considering the prognosis, it must be born in mind that the majority of patients do not present themselves for treatment until the disease has progressed to a fairly late stage, for until complications from pressure, etc., arise the patient is apt to be without symptoms. Statistics from this series of cases show a very poor prognosis. Five were discovered at autopsy. Ten cases when first seen were considered inoperable and accordingly no

intervention was made. Four of these cases were lost sight of. The remaining six all died in less than one year. In seven cases exploratory laparotomy only was done, the tumor mass at time of operation being either so large or so adherent that excision was thought inadvisable.

In 37 cases excision was done. Four of these died shortly after operation from causes directly traceable to operative interference, an operative mortality of 10 per cent. Of the remaining 33 cases the ultimate result is not known in 18. Of the 15 cases in which the result is known, 8 were reported dead within one year. Of these 8, 3 died during the first three months after operation, three during the second three months, and the other two within the year. All these eight cases died from recurrence. Of the seven cases reported well, 2 are known to be well 3 months after operation, 1 for four months, 1 for six months, 1 for two years and three months, 1 for two years and ten months, and 1 for three years. Beyond these periods of time none of the cases were traced.

The results of operation *after the onset of symptoms* are therefore very poor. Of 47 cases operated upon, only 3 are known to be alive and well after two years.

### TREATMENT

The proper treatment directed towards the permanent cure of these cases therefore hinges on one of two possibilities, either the removal of the testis before malignant growth starts, or removal after such growth starts but before the onset of symptoms.

Volumes have been written on the treatment of the undescended testis and it is not the purpose of the writer to further discuss this question, except as it may directly bear on our subject. In the treatment of each case of abdominal undescended testis the question resolves itself into whether an attempt shall be made to replace the organ in the scrotum, whether it shall be left in the abdominal cavity and only the oft associated hernia repaired, or whether the organ shall be removed. The value of transplantation to the scrotum other than for cosmetic purposes is decidedly questionable, for the abdominal testis usually lacks the power of spermatogenesis and it is pretty generally agreed that the mechanical act of transplantation does not *create* this power in the organ. A priori, there is no reason to see why it should do so. Cases of spermatogenesis and fertility have been recorded following transplantation, but, as Eccles (23) points out, there is abundant proof that the arrested testis is "capable of producing well formed and active spermatozoa. This fact has been indubitably proved by the microscopical examination of the semen which has been ejaculated and of the lining epithelium of the tubules themselves, in addition to the evidence of the procreation of children." It is possible if not probable that the cases of transplanted testes which have become fertile would have functionated *within* the abdomen. Orchidectomy is not justifiable before the age of puberty, as many testes do not completely migrate to their normal position until that time. It seems to the writer that instead, as is so often done, of operating on these cases of abdominal testes before the age of puberty it would be better and more conservative surgery to advise the patient against operation, excepting always those cases having associated hernia demanding immediate relief. The patient should invariably be told of the possibility of malignant degeneration and impressed with the necessity for reporting at a later date for observation. At this later date many of the testes will be found to have migrated into the scrotum.

Cases presenting themselves after the age of puberty present a different problem. The patient has then passed the age of probable late descent and is entering upon the period of sexual activity, the period in which the large majority of malignant testicular degenerations take place. The question now arises as to the possibility of degeneration. This is relatively small, for taking together the figures of Marshall (48) and Monod and Terillon (54) we found 1 cryptorchid in 800 men examined while we found 1 malignant cryptorchid in 60,000 men. Thus we can state roughly that about 1 in every 75 abdominal testes will become malignant. This estimate is, however, probably too high. It is the opinion of

the writer that if the individual has one testicle in the scrotum, the abdominal testis should after puberty be removed. The question arises as to what part in the general body growth the undescended testis plays. In man there is only rarely a compensatory hypertrophy, while in the stallion there is such an hypertrophy. The removal of one testicle is probably harmless.

Thirty-one of our cases were *single* cryptorchids developing malignancy in the abdominal testicle. All would have been saved had an abdominal orchidectomy been done *before the onset of malignancy;* that is, shortly after puberty.

It is less easy to render judgment on the double cryptorchids. These cases should also be warned of the possibility of malignant degeneration and examined at frequent intervals. It can be only by repeated examination of these patients that early objective symptoms followed by operation and good results will be obtained. It hardly seems justifiable in the absence of subjective or objective signs to advise double orchidectomy.

After the onset of symptoms of malignancy, or as soon as a diagnosis of tumor is made, immediate abdominal orchidectomy should be done. Whether the operation consists of simple orchidectomy or more involved procedures, such as the removal of glands or resection of structures to which the mass is adherent, must be decided for each individual case at the time of operation. It must be borne in mind that extension takes place by the lymphatics. Chevassu (13) believes that it always takes place in this manner and that extension by the blood stream can take place only by way of the thoracic duct or by direct involvement of the spermatic or renal vessels or the inferior vena cava. The glands to which particular attention should be paid are those situated around the aorta and vena cava from their bifurcation below to the level of the renal artery above. Excision of these, together with the malignant testicle, should in the early cases give but a very low operative mortality and a large percentage of permanent cures.

## CONCLUSIONS

1. Malignant disease of the abdominal testis is relatively rare, but frequently overlooked. In general hospital male admissions it is seen about once in each 60,000 cases. About one in every four cases of malignant abnormally situated testicle is found within the abdomen. About one malignant abdominal testicle occurs to each fifteen malignant scrotal testicles. About one of each seventy-five abdominally retained testes will become malignant.

2. Cases occur mainly during the years of greatest sexual activity, may occur in apparent females, and are slightly more frequent on the right than on the left side.

3. The structure of the tumors differs markedly, but most of them are probably teratomata. Other associated congenital malformations are fairly frequently found.

4. Symptoms do not occur until the size of the tumor or its metastases cause pressure.

5. The prognosis is bad. Of the 59 reported cases, only 3 are known to be alive and well after two years.

6. Treatment should be excision, preferably before the onset of symptoms and after the age of puberty.

In closing I wish to express my indebtedness and thanks to Dr. J. A. Blake for permission to publish the two original cases; to Dr. W. C. Clark for most valuable assistance in pathology; and to Dr. Boleslaw Lapowski for translations from the Russian.

ABSTRACT OF CASES FROM THE LITERATURE OF MALIGNANT DISEASE OF THE ABDOMINAL TESTICLE (ARRANGED CHRONOLOGICALLY).

CASE 1. 1859. Johnson (32). Male, age 27. Following blow on abdomen from cricket ball patient developed pain in abdomen, bladder symptoms, abdominal mass, and constipation. Right testicle in scrotum. No operation. Died five years after onset of symptoms. Autopsy showed tumor mass containing many cysts. Weight, 14 pounds. Diagnosis, carcinoma.

CASE 2. 1861. Martin (49). Male, age 17. Left scrotum empty. Three years previously blow on abdomen giving sickening testicular pain. Swelling size of egg appeared and remained stationary for two years. Then sudden pain in mass after exercise with enlargement of tumor. Operation. Mass adherent to bladder. Diagnosis, "Fibro cystic encephaloid degeneration." End result not stated.

CASE 3. 1881. Bögehold (10). Male, age 30. Double abdominal cryptorchid. For six months right testicle enlarged. Now size of fist. Laparot-

omy and excision. Operative recovery. End result not given. Diagnosis, sarcoma. First reported operative case.

CASE 4. 1881. Mathieu (50). Male, age 49. Autopsy case. Died of apoplexy. Said to have had abdominal tumor for twelve or fifteen years. Autopsy showed double cryptorchid. Sarcoma left testicle and left kidney. Weight of testicle, 460 grams.

CASE 5. 1882. Gaillard (27). Male, age 30. For four years had noted tumor mass in left lower abdomen. Considered inoperable. Died. Autopsy showed a malignant testicular tumor in left iliac fossa near internal ring. Metastases in lumbar lymph nodes, psoas muscle, left ureter (causing hydronephrosis) and in periosteum of vertebral column.

CASE 6. 1885. Wells (82). Male, middle aged. Father of children. Left testis in scrotum. Right absent. Abdominal tumor for one year. Laparotomy. Mass adherent to surrounding structures. Shelled out of capsule (tunica vaginalis?) and removed. Died on third day from peritonitis. Weight of tumor nine pounds. Diagnosis, malignant tumor. Tunica not invaded.

CASE 7. 1886. Maydl (51). Male, age 39. Double cryptorchid. Atrophic right testicle palpable in right inguinal canal. First degree hypospadias. For two months abdominal pain. For one month abdominal tumor. Laparotomy, removal very difficult. Intestinal resection necessary. Died one month later from recurrence. Diagnosis, round-celled sarcoma.

CASE 8. 1887. Von Kahlden (81). Male, age 44. For one year dragging pain in abdomen. Double cryptorchid. Laparotomy and right castration. Operative recovery. End result not given. Diagnosis, myxosarcoma.

CASE 9. 1891. Abel (1). Female, age 31. Hermaphrodite. Menstruation regular since age of 20. For some months abdominal pain independent of menses. Bowels and urination normal. Cystic mass felt in left lower abdomen. Vagina small. Cervix indefinite. Thought to be atresia vagina and hæmatometra. Posterior colpotomy followed by death from spreading peritonitis. Autopsy showed mass to be sarcoma of retained left testicle. Right testicle in inguinal canal.

CASE 10. 1892. Picqué (62). Male, age 34. For eight months pain in lower abdomen. For seven months tumor. Mass felt in left lower abdomen and pelvis. Some constipation and dysuria. Laparotomy. Mass adherent to omentum and small intestine. Attached to internal ring by pedicle. Removed. Operative recovery. End result not given. Diagnosis, cancer.

CASE 11. 1893. Farwick (26). Male, age 39. Pain in abdomen for one month. Laparotomy and excision. Mass size of adult head. Operative recovery. End result not given. Diagnosis, mixed sarcoma.

CASE 12. 1894. Bütjagin (11). Male, age 49. Double cryptorchid. Very small penis. Scrotum undeveloped. Hæmaturia for two years followed by abdominal tumor. Developed a left subclavicular adenopathy. Considered inoperable. Autopsy showed large mass compressing vessels of leg and bladder. Metastasis in prostate. Diagnosis, sarcoma.

CASE 13. 1895. Silberberg (73). Male, age 36. For some months pain in abdomen radiating to lower extremities. Sensation of pressure. Difficulty in urination. Left cryptorchid. Laparotomy. Tumor of left testicle adherent to and involving left kidney. Mass removed leaving kidney in place, operator expecting to remove it by lumbar incision at a later date. Patient developed peritonitis and died. Autopsy disclosed absence of right kidney and double ureter from left kidney. Diagnosis, sarcoma.

CASE 14. 1896. Riedel (66). Male, age 38. Right cryptorchid. Truss for right inguinal hernia for 24 years. For four years abdomen increasing in size. For one week dyspnœa and œdema of feet. Laparotomy. Mass extraperitoneal behind iliac vessels. Removed with difficulty. Well three months after operation. Diagnosis, round-celled sarcoma.

CASE 15. 1896. Eigenbrodt (24). Male, age 30. Left cryptorchid. For two weeks pain in abdomen followed by mass. Pale, cachectic. Mass filling lower abdomen. Right testicle in scrotum. No children. Slight hypospadias. Laparotomy. Few adhesions. Broad pedicle at internal ring. Excision. Free from recurrence three years later. Diagnosis. Spindle-cell sarcoma.

CASE 16. 1896. Balloch (3). Male, age 20. Left cryptorchid. Abdominal pain and tumor for a number of years. Laparotomy. Inoperable mass adherent to bladder, rectum, and pelvis. Died two weeks later. Autopsy; diagnosis, round-celled sarcoma.

CASE 17. 1897. Pike (63). Male, age (?). Double cryptorchid. Complained of œdema of right leg. Cleft palate, double club feet. Laparotomy. Excision. Operative recovery. Weight of tumor, 3 pounds, 6 ounces. Ultimate outcome not known. Diagnosis, round-celled sarcoma involving globus major and minor.

CASE 18. 1897. Kaufmann (36). Male, age 26. Right cryptorchid. For five weeks pain in abdomen and legs. Abdominal mass and œdema of left leg. Refused operation. Uræmia, pneumonia and death. Autopsy showed carcinoma of left testis, also involving epididymis. Adherent to omentum, rectum and left ureter, pressure on both ureters causing double hydronephrosis.

CASE 19. 1898. Schmidt (69). Sarcoma of testis lying in upper part of pelvis.

CASE 20. 1898. Gerster (28). Male, age 21. Double cryptorchid. No erectile body of penis. No penile urethra. Third degree hypospadias. One day acute history of abdominal pain, vomiting, fever, and mass in right lower abdomen. Laparotomy. Sarcoma testis size of child's head, with

twisted pedicle, removed. Post-operative history not given.

CASE 21. 1898. Kronpecher (40). Male, age (?). Double cryptorchid. Small round-celled sarcoma.

CASE 22. 1898. Meiser (53). Male, age 45. Left cryptorchid. Right testicle in inguinal canal. For seven years obstinate constipation. For six weeks abdominal pain, constipation worse, burning urination. No children. Sexual appetite lacking. Laparotomy. Excision of mass. Weight 1020 grams. Died in three months from recurrence. Diagnosis, sarcoma.

CASE 23. 1898. Primrose (64). Male, age 32. Double cryptorchid. Abdominal tumor for three months. Laparotomy. Inoperable. Died a few hours after operation. Autopsy showed well formed uterus and vagina between bladder and rectum. Also rudimentary Fallopian tubes. No vasa deferentia or seminal vesicles found. Diagnosis, sarcoma.

CASE 24. 1899. Kaeppelin (33). Male, age 40. Right cryptorchid. One child. Left testicle in scrotum. Pain in abdomen and slowly developing mass. Laparotomy and excision. Pedicle at internal ring. Operative recovery. End result not given. Diagnosis, epithelioma.

CASE 25. 1900. Kayser (37). Male, age 29. For five weeks pain at stool. Recently abdominal pain. Laparotomy and excision. Metastases felt in liver at time of operation. Died four months later of metastases. Diagnosis, sarcoma.

CASE 26. 1900. Pederson (60). Male, age 27. At age of 13 baseball drove left testicle into abdomen. Abdominal tumor of gradual growth for fourteen years. Laparotomy. Excision. Operative recovery. Eventual outcome not given, but getting worse when last seen. Diagnosis, large round-celled sarcoma.

CASE 27. 1900. Marchand (46). Male, age 24. Double cryptorchid. Abdominal tumor for four months. Laparotomy. Inoperable. Brother said to have died of same disease. Death. Autopsy, well formed uterus. Mass adherent to mesentery, abdominal wall and bladder. Metastases in liver. Diagnosis, carcinoma.

CASE 28. 1901. McDonagh (52). Male, age 40. Tumor of right testicle. Mass lying partially in abdomen and partially in inguinal canal. Excision. Weight 2½ pounds. Outcome not given. Diagnosis, large round-celled sarcoma.

CASE 29. 1901. Souligoux (74). Male, age 27. Left cryptorchid. For three weeks abdominal pain and vomiting. Some diarrhœa. Mass in left inguinal region thought to be testicle but at operation found to be varicocele. Second mass in abdomen. Inguinal mass first cut down upon, mistake discovered, and abdominal mass removed. Operative recovery. Ultimate outcome unknown. Diagnosis, epithelioma apparently of Wolffian origin.

CASE 30. 1902. Scudder (71). Male, age 28. Double inguinal hernia. Left cryptorchid. Abdominal mass for three months. Laparotomy, excision. Bloody peritoneal fluid. Operative recovery. Died seven months later from recurrence. Autopsy showed round-celled sarcoma with metastases into spinal cord from eleventh dorsal to first lumbar vertebræ.

CASE 31. 1902. Derlin (20). Male, age 37. For one and one half years abdominal pain. For four weeks swelling of right leg. Laparotomy. Mass size of goose egg excised from near right sacro-iliac joint. Short mesorchium. Operative recovery. Ultimate outcome not given. Diagnosis, round-celled sarcoma.

CASE 32. 1903. Shevandin (72). Male, age 33. Right cryptorchid. Pain in back and lower abdomen where a mass is felt. Laparotomy. Inoperable. Œdema of lungs; death. Autopsy showed mass filling abdomen from diaphragm to second lumbar vertebra. Pelvis filled with tumor nodules. Nodules in mesosigmoid, on peritoneum covering liver and spleen, in membranous urethra, and in lungs. Diagnosis, sarcoma.

CASE 33. 1903. Benenati (6). Male, age 40. Left cryptorchid with left inguinal hernia. Father of children. For three years obstinate constipation and slow development of abdominal mass and pain. Autopsy showed rhabdomyoma.

CASE 34. 1904. Darby (19). Male, age 24. Congenital left inguinal hernia and left cryptorchid. Hypospadias. Weakness, pain in back and œdema of right leg. Inoperable abdominal mass. Autopsy showed mass occupying major portion of abdomen with a broad base adherent to lumbar spine. Liver free. Diagnosis, carcinoma.

CASE 35. 1904. Rademacher (65). Male, age 33. For three months abdominal tumor. Laparotomy. Enormous retroperitoneal mass extensively adherent. Attempt at removal. Death eight hours after operation. Diagnosis, round-celled sarcoma.

CASE 36. 1904. Odiorne and Simmons (57). Male, age 28. Laparotomy. Excision. Death in one year from recurrence. Diagnosis. Large round-celled sarcoma.

CASE 37. 1904. Odiorne and Simmons (57). Male, age 46. Laparotomy. Excision. Died two months later from recurrence. Diagnosis, round-celled sarcoma.

CASE 38. 1904. Odiorne and Simmons (57). Male, age 46. No operation. Death one year after coming under observation. Diagnosis, sarcoma.

CASE 39. 1904. Tousey (80). Male, age 33. Double cryptorchid. Right inguinal hernia. Absence of penis. Hypospadias. Claw-like deformities of hands and feet, some phalanges being absent. Emaciation and abdominal pain for two years. Laparotomy. Excision. Recurrence in two months. Died 5½ months after operation. Diagnosis, carcinoma.

CASE 40. 1905. Marion (47). Female, age 36. Married for sixteen years. Never menstruated. Complained of abdominal tumor. Feminine frame. Breasts and external genitals normal. No hair on face. No cervix. Laparotomy with diagnosis of uterine fibroid and imperforate cervix. Mass ad-

herent by pedicle to innominate line. No uterus or ovaries. Mass excised. Diagnosis, alveolar sarcoma of right testis. No spermatozoa found.

CASE 41. 1905. Scott and Longcope (70). Male, age 45. Cryptorchidism not noted during life. Complained of cough, dyspnœa, and general weakness of some months' duration. Blood-stained sputum. For three months severe right sciatica. Some loss of weight. Autopsy showed double cryptorchid. Diagnosis, chorio-epithelioma of right testis with metastases to retroperitoneal lymph nodes, rupture into inferior vena cava, secondary growths in lungs, liver, myocardium, spleen, kidneys, stomach, intestine.

CASE 42. 1905. Mantovani (45). Male, age 52. Right cryptorchid. Father of six children. For seven months pressure in abdomen, anorexia, loss of weight. For one month abdominal mass. Laparotomy. Excision. Operative recovery. End result not given. Diagnosis, cancer.

CASE 43. 1905. Wyeth (83). Male, age 30. Left cryptorchid. Right testicle in inguinal canal. Right inguinal hernia. No children. Lost 15 pounds in weight. Laparotomy. Double castration. Well four months after operation. Diagnosis, sarcoma of both testes.

CASE 44. 1905. Stiles (77). Male, age 39. Right cryptorchid. For seven months attacks of abdominal pain of short duration with frequency of urination. Laparotomy disclosed strangulated sarcomatous right testicle. Excision. Operative recovery. Well three months later.

CASE 45. 1906. Blanck (7). Male, age 37. Right cryptorchid. For one month abdominal pain, poor appetite, and constipation. Laparotomy. Excision. Free from recurrence two years and ten months after operation. Diagnosis, carcinoma.

CASE 46. 1906. Cocuzza (14). Male, age 34. Double cryptorchid. For five years abdominal tumor. Laparotomy. Excision. Operative recovery. End result not given. Diagnosis, sarcoma.

CASE 47. 1906. Cocuzza (14). Male, age 27. For eighteen months mass size of hen's egg in right lower abdomen. Excision. Operative recovery. End result not given. Diagnosis, sarcoma.

CASE 48. 1907. Le Conte and Crispin (42). Male, age 28. Double cryptorchid. Acute history of abdominal pain, fever, and vomiting. Examination showed generalized abdominal tenderness and tumor mass in right lower abdomen. Laparotomy for appendix abscess with spreading peritonitis. Instead a strangulated large round-celled sarcoma with pedicle attached about two inches above internal ring found. Excised. Weight 410 grams. Operative recovery. End result not given.

CASE 49. 1907. Stefanoff (76). Male, age 32. Double cryptorchid. Recurrent attacks of abdominal pain, tenderness, nausea, and diarrhœa. Laparotomy. Inoperable retroperitoneal mass with many smaller tumors. Death six days later. Autopsy. Teratoma with metastases only on serosa of intestine and mesentery.

CASE 50. 1907. Boese (9). Male, age 38. Father of six children. For seven months pain in abdomen, and mass. Laparotomy. Excision. Weight of mass 110 grams. Pedicle attached to retroperitoneal tissue in left iliac fossa and had half a twist in it. Operative recovery. End result unknown. Diagnosis, strangulated sarcoma testis.

CASE 51. 1907. Osler (59). Male, age 29. Double cryptorchid. Double inguinal hernia. Effeminate. For eight weeks abdominal mass, loss of flesh and strength. Considerable ascites. Laparotomy. Inoperable. Died one month later.

CASE 52. 1907. Osler (59). Male, age 46. Left cryptorchid, and left inguinal hernia. Pain in the abdomen for three weeks. Increasing constipation. Diagnosis, sarcoma.

CASE 53. 1907. Osler (59). Male, age 45. Right cryptorchid. Pain in abdomen for three months. Laparotomy. Inoperable. Death nine months after onset of symptoms. Diagnosis, sarcoma.

CASE 54. 1909. Kaltenbach (35). Male, age 29. Double cryptorchid. For three weeks weakness of left leg. For eight days swelling of leg. Laparotomy showed inoperable mass. Died two days later. Autopsy showed sarcoma of left testicle with metastases into retroperitoneal and preaortic lymph nodes, and around rectum and sigmoid. Atrophied right testis. Double right kidney and double right ureter, left hydronephrosis and angioma of liver.

CASE 55. 1910. Pfaff (61). Male, age 38. Familial history of cancer. Left cryptorchid and inguinal hernia. For three months point of soreness in lower abdomen. Pain during coitus. Laparotomy. Mass with pedicle attached to internal ring excised. Reported five months later as dying from recurrence. Diagnosis, large round-celled sarcoma.

CASE 56. 1910. Sabella (68). Male, age 23. Right cryptorchid. Three months previously left sarcomatous scrotal testicle removed. Had noted for years a mass in right lower abdomen, recently enlarging. Laparotomy. Excision. End result not given. Diagnosis, sarcoma.

CASE 57. 1912. Tirumurti (79). Male, age 35. Right cryptorchid. For two months pain in abdomen and thorax. Autopsy showed mass adherent to ileum, sigmoid, rectum, and bladder, Metastases in lung, liver, kidney, pancreas and brain. Cryptorchidism, not noted until autopsy. Diagnosis, chorio-epithelioma.

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# EDUCATIONAL WORK IN CARCINOMA OF THE UTERUS[1]

By HOWARD C. TAYLOR, M. D., New York City

IT is not my intention at this meeting to consume any time in recalling to your attention the high mortality from carcinoma of the uterus in this country, nor the bad results of our operative interference. From papers read before this society last year, from general medical literature, and from our own personal experience, each of us is convinced of the unsatisfactory position of carcinoma work in this country. We have made great advances in operative technique, we do a far more extensive operation now than was done even a few years ago, but our results are universally bad. We all know that the cases come to us late and at a period when little can be done, but we know that many cases of carcinoma of the uterus are of a relatively small degree of malignancy, that it remains a local disease for a considerable time, and it is our belief that if we had seen the cases at an earlier stage of the disease that we could probably have cured some of the patients. Furthermore, we learn from the patient in many cases that she noticed, months before she applied for relief, symptoms which to our minds were the early manifestations of the disease, and which the patient ignored, partly through neglect but largely through ignorance. Not infrequently we learn from the patient that months before she consulted a physician, who made no examination nor any attempt to attain an exact diagnosis nor to institute proper treatment for the condition.

The question before us to-day is this ignorance of women in regard to the early symptoms of carcinoma of the uterus, and this ignorance, or neglect, or indifference to their responsibilities of American physicians. The real extent of this ignorance and neglect is well illustrated by statistics given in the report of the Cancer Commission of the Pennsylvania State Medical Society, of which Dr. J. M. Wainright of Scranton is chairman. In an analysis of eighty-two cases of carcinoma of the cervix, it was found that there was an average loss of one year between the time the first symptoms were noticed and the patient came to a radical cure, and that the average time lost between the first consultation with a physician and the operation was eight months. Are we not, as members of the American Gynecological Society, a national society the object of which is "the promotion of knowledge in all that relates to the diseases of women," at least indirectly and in part responsible for this condition of affairs?

During the past year, I have frequently discussed with medical men, the advisability of the campaign directed toward the education on the subject of carcinoma of the uterus, in order that we may get the cases for operation at an earlier period. Practically everyone admits the advisability of doing this. There are, however, some differences in the minds of different men as to the best methods of doing it. One set of men believes that it is wise to direct our attention entirely to the medical profession, and to leave to the individual physician the responsibility of teaching his own patients the early symptoms, the necessity of examination, and the course to follow in carcinoma of the uterus. Another set of men believes that the better way is to go directly to the laity with the idea of giving them certain definite simple symptoms which they can readily understand, telling them that these symptoms may indicate cancer, not that they necessarily do, but that they may indicate cancer, and teaching them the importance, when these symptoms are present, of going to a competent surgeon for examination and such subsequent treatment, if any, that may be necessary. It is my belief that both methods should be used. I believe that there is much to be accomplished by repeatedly impressing the physician with the necessity of early diagnosis if anything is to be accomplished in the treatment of carcinoma of the uterus, and of his direct responsibility if any case comes under his care and she is not given the benefit of an examina-

[1]Read before the American Gynecological Society, Washington, D. C., May 7, 1913

tion to determine the cause of such symptoms as she may have. I believe, however, that it is not best nor wise to leave to the general practitioner the teaching of their women patients. Furthermore, and I believe that this is an important one, I know of no better way to impress upon the general practitioner his personal responsibility for the proper handling of the cases that come under his care, than the knowledge that the laity has been told by competent authorities, certain definite things as regards cancer, and that the laity will know if he makes any mistake in an individual case. If a general practitioner knows that any mistake he makes in regard to cancer will be known to the community, he will be more careful that such a mistake does not occur and that the doubtful case is in the hands of some one who knows how to give her the benefit of the most modern method of diagnosis. If we could teach women that any lump in the breast may be a cancer and that the only way to be absolutely sure whether it is or not, is to remove it and have it examined microscopically, few general practitioners would have the courage to make a positive diagnosis that any lump in the breast is a benign condition and does not need removal. This fact is well illustrated by the attitude of the laity in regard to appendicitis at the present time. It is no longer necessary to urge an operation for appendicitis; as soon as the diagnosis of acute appendicitis is made, the family wants to know how soon it can be done and to what hospital the patient should be sent. The physician who makes a mistake in the diagnosis of appendicitis or neglects an early operation risks his reputation in the community in which he lives.

This is as it should be, and as it should be relative to carcinoma of the uterus, and as it will be when the laity has the same knowledge of carcinoma of the uterus that it now has of appendicitis. The mere fact that the physician knows that his patient has been, or may have been, taught this simple, clean-cut fact will make him more alert as to the condition himself.

In regard to the way that such a campaign should be carried on, it should, I think, be conducted on the same plan that any publicity campaign is conducted. There is beyond question a perfectly legitimate use, even for a medical man, of the publicity man and press agent. He is constantly used in the political world and the business world, and there is no reason why we should not also use him to accomplish medical ends. There is, at present, a very definite public health movement going on throughout the country. Newspapers and periodicals of the highest type will now accept and publish articles that they would not dream of doing five years ago. Journals now are willing to accept articles on eugenics and on venereal diseases and they would certainly not make any objection to articles on such subjects as carcinoma of the uterus and carcinoma of the breast. A number of very prominent monthly and weekly papers have signified their willingness to publish such articles for us.

In considering any definite plan to undertake a campaign of education on the subject of carcinoma of the uterus it must be understood that it will involve a great deal of labor over a considerable period of time, running probably into years, and that the direct result may be difficult to see. It should be undertaken only with the conviction that it is the right thing to do, and with a willingness to continue it because of that belief even if the results are not directly apparent. The labor involved is such that there is probably no man or group of men engaged in clinical practice of medicine who will have the time to devote to carrying it out. Therefore it must be done largely by laymen. It would, however, be necessary that the work should be carried on under definite medical supervision.

A campaign of education on the subject of cancer is not unlike the campaign of education that has been carried on during the past few years on the subject of tuberculosis, and we are fortunate in being able to profit by the experience gained in that work.

In the educational work on tuberculosis there has been located in New York a controlling force which has had the general direction of the work, with a large number of subcommittees throughout the country. Free use has been made of the newspapers and

magazines in the publication of articles and press bulletins. These articles and press bulletins are written largely from choice by laymen. These press bulletins are short articles of one hundred to five hundred words on the relationship of tuberculosis to some popular subject, as a news item and mailed to about eight thousand newspapers about every two weeks. There is in this a large amount of publicity at a comparatively small expense. Frequent use is also made of exhibits, lectures, circulars, etc. The subcommittees or local societies throughout the country assist in local lectures and papers, distribution of literature, etc., under the direction of the central body.

If this work is undertaken there should be a central committee composed of rather a large number of men who would have a general direction of the work, and general supervision of all literature. It would be necessary for this committee to employ, on a fair salary, some laymen to take over the detail work of the movement, including writing of any articles to appear in the magazines and also such press bulletins as may be sent out to the newspapers throughout the country.

One of the first essentials in the early recognition of carcinoma of the uterus is the routine microscopic examination of tissue removed from every suspicious case. This microscopic examination of all tissue removed in any case should be within the reach of every woman and should be free to every woman who cannot easily afford to pay for it. The Board of Health in New York and other cities has for years made without charge the bacteriological examinations necessary to positively diagnose or exclude diphtheria. It has furnished the necessary sterile tubes, established receiving stations, and made the collections in order to get all the doubtful cases by making it easy to both physician and patient. To accomplish this same end, there should be an arrangement made for the free examination of all suspected tissue. The nature of this arrangement would vary in different places. In a city like New York, it should be possible to have this done in the Board of Health laboratories, and I think it would not be difficult to make such an arrangement. Under some circumstances, this work might be undertaken in the laboratory of a medical school or hospital. From small places the tissue, properly preserved, could be mailed to a larger center. Detailed instruction for removing tissue, preserving and mailing it to the proper place should be in the hands of every physician. In short, the microscopic examination of all doubtful tissue is a legitimate public expense and it is my belief that it is our place to show the public the importance and necessity of these examinations and that the expense will be met.

There are in this country no reliable statistics on carcinoma of the uterus. This was well illustrated by the papers read before this society last year. A few men have a small list of cases, but we have no correct estimate of the number of cases in the country, the percentage of operability nor cures. We have in fact very little that we can state to the public that is based on accurate statistics, and can only make the abstract statement — based on experience and opinion, but not on accurate statistics — that if the case is seen early we can effect a cure in many cases. The securing of accurate statistical information on cancer of the uterus in the United States should be an important function of this general committee, and to accomplish this the free examination of tissue should depend on the willingness of the physician to keep the committee (possibly through the laboratory making the examination) informed as to the course and outcome of the case.

In this way accurate statistics based on reliable examinations would be obtained. One of the duties of this central committee which is of the greatest importance is the formation of subcommittees or societies to carry on the work in different places. Educational work is always largely local. Men in one state cannot educate women in a distant state as it must be done locally. The formation of these subcommittees or societies should be done with great care because unless the right men are placed in charge nothing will be done. These committees should be made up so far as possible of members of the American Gynecological Society, but in such states or parts of the country where we have no mem-

bers the committee should be made up of medical men who are not members of this society but who are interested in the work. Use should also be made of any society or organization that is interested in the work and willing to take a part in it. The general committee, made up of men more particularly interested in the subject and possibly more directly interested in the success of the movement, would act as an advisory committee to these subcommittees in a general way, suggesting what is wise to do in different communities.

As an outline of what these local committees might do I would suggest the following things:

It might be that each county society in the state hold at least one meeting a year on the subject of cancer, laying particular stress on the importance of early symptoms and the early operation.

It could see that the local medical journals carry in repeated editions, as one of the New York medical journals offered to do for me, a short article giving the early symptoms of carcinoma of the uterus, in order to impress them more forcibly on the minds of medical men. The notices sent out by these medical societies might include short notices of the early symptoms of carcinoma of the uterus.

The notices of the Medical Society of the County of New York, for some years past, have contained a small card relative to the milk commission. It would seem to me that possibly they would be willing now to drop the notices of the milk commission for a time and enclose instead, or possibly along with it, a card containing the early symptoms of carcinoma of the uterus. Not that the medical men do not know these but in order to impress more definitely on their minds the necessity of paying attention to these symptoms. So much for the further education of the medical men in a given community.

So far as the education of the people themselves is concerned, nothing would be more important than more careful education of all trained nurses. Every class graduating from a training school should have one or more lectures on the symptoms and the importance of the recognition of these symptoms in carcinoma of the uterus. Because no class learns the symptoms from patients earlier than the nurses. If nurses knew the importance of irregular bleeding we would get some cases earlier. In other countries the education of midwives on the subject of carcinoma of the uterus has brought very favorable results. While the results in this country are not so striking, certainly in our large cities such as New York, where the midwives deliver a very definite percentage of women and their influence among a certain class in the community is very definite, there is no question that much could be accomplished by more careful education of midwives as to symptoms of carcinoma of the uterus.

The local committees should be prepared to deliver lectures on the subject of carcinoma of the uterus and its early symptoms and the importance of early operation, before any body of women who express the desire for such information. It might include women's clubs, school teachers, mothers' clubs and so on. In general the subcommittees should be ready to co-operate with the main central committee and carry out, in its own community, work done in other places by similar committees.

# LESIONS OF THE HYPOPHYSIS FROM THE VIEWPOINT OF THE SURGEON

By CHARLES H. FRAZIER, M. D., Philadelphia

DURING the past six years or more, the hypophysis has been the object of study from many points of view. Elaborate contributions have been made to the physiology, the pathology, and the treatment of pituitary disturbances, but despite the number of experiments, despite the number of autopsies and of operations, there remain many problems in the pituitary question still unsolved.

Many of these, if not most of them, are of more than academic interest, and vitally concern the surgeon in his efforts to deal intelligently with the manifold expressions of hypophysial disorder. Not the least of these is the question as to whether one or all of the component parts of the hypophysis are essential to life. It is not necessary to refer in detail to the investigations of Horsley, Biedl, Friedmann and Maas, Lomonaco, Fichera, Gemelli, Gaglio, Allen and Sweet, on the one hand; or of Marinesco, Vassale and Sacchi, Gatta, Caselli, Pironne, Paulesco, Garnier, Thaon, Livon, Narbout, and Cushing on the other. Suffice it to say that they are absolutely contradictory in their results. From the standpoint of accuracy in observation, and delicacy and refinement in technique, nothing is left to be desired in the research of Sweet and Allen, who assert unequivocally that the removal of the entire hypophysis is not incompatible with the metabolic processes essential for the maintenance of life. Irrespective of the methods of exposure, the surgeon is confronted at once with the problem as to how much tissue may be removed at any given operation. Could anything be more unsatisfactory for the surgeon after exposure of a lesion than to be uncertain as to how best to deal with it? I have gone over in great detail the descriptions of many operations by many operators, and have been impressed with the extraordinary lack of detail as to the methods in which the tumor was dealt with. This commentary is not advanced as a reflection on the technique of any individual or individuals, but cited merely to call attention to a very serious obstacle that confronts the surgeon. The following, for example, are quotations from the descriptions of operations taken at random: "large fragments of friable growth scooped out;" "large pulsating mass bulged through opening and partially removed;" "removed intrasellar part of tumor;" "removed large part of tumor."

Time will not permit of any discussion of the respective functions of the component parts of the pituitary body. This, however, is not germane to the subject. But we must revise our conceptions sooner or later with reference to the symptom-complex of pituitary disease. Were it possible, it would be most desirable to be able by a careful analysis of the symptoms to know in advance of the operation something of the character of the lesion; i.e. whether a struma, hyperplasia or tumor. As a matter of fact, this is altogether out of the question. There is the widest variation in the expressions of the disease, wholly irrespective of the pathological process. There has been an attempt to distinguish between the so-called hyperpituitary and the hypopituitary group of cases, and yet there are many instances in which combined in the same case there is the expression of both the acromegalic type of Marie and the dystrophic type of Fröhlich, and yet again there are others where there is no evidence whatsoever of any disturbance of the metabolic processes, as in two cases upon which I recently operated where the only symptoms were due to pressure on the optic chiasm and to intracranial tension. One of these patients had been under observation many months, and yet the true nature of the lesion was not recognized until an X-ray revealed the structural alterations in the sella turcica (Fig. 1). In one of the cases reported by von Eiselsberg[1] both acromegaly and dystrophy phenomena were

[1] Arch. f. klin. Chir., 1912, c, 1.

Fig. 1. Skiagraph of patient without symptoms peculiar to pituitary disease other than the headache and optic atrophy, showing the characteristic enlargement of the sella turcica.

conspicuous; at the operation an adenoma was found and in part removed.

The impression has become prevalent that acromegaly is the result of a hypersecretion such as might accompany simple hyperplasia or perhaps an adenoma, and yet there are instances, as in the case reported by Kocher[1] where the histological examination of the tumor revealed a round-celled sarcoma.

To illustrate further the absolute lack of conformity, I might cite one of my own cases as an example (and many others are to be found) in which the specimen which I removed at operation proved to be an adenoma, and yet there were absolutely no evidences of acromegaly or of any other tissue change, though the tumor had been present long enough to cause atrophy of both discs (Fig. 2). This phase of the subject might be illustrated *in extenso*, but enough has already been said

[1] Deutsche Ztschr. f. Chir., 1909, c.

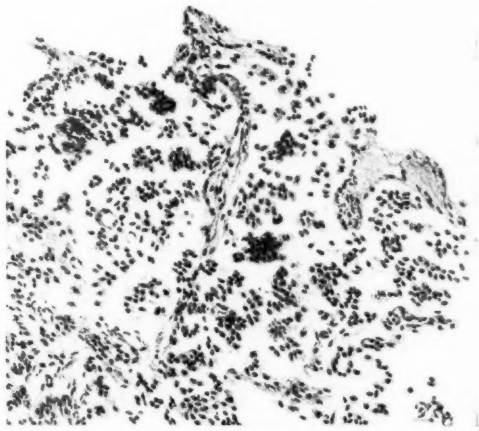

Fig. 2. Histological drawing of portion of adenoma removed from patient in whom there was no evidence of acromegaly or any other tissue change. The tumor had been present long enough to cause atrophy of both optic discs.

to show that there is the widest variation in the clinical expression of pituitary lesions, that the hyperplastic or the dystrophic type, either separately or in conjunction, may owe their origin to the same lesion; and vice versa, a similar lesion may be accompanied by neither type. These remarks have been introduced not to suggest any discussion of the physiology of the gland either in its normal or perverted state, but merely to call attention to the fact that prior to operation the surgeon can surmise nothing of the character of the lesion with which he may have to deal.

The naked eye appearance of the growth as described by the operator is of no value whatsoever, except in those cases in which the tumor is a simple cyst. Thus, in the operative notes of a number of cases taken at random, we find the following phrases:

| Description of tumor at operation | Histological report |
|---|---|
| "Cystlike structure with gelatinous contents removed" | Hyperplasia |
| "Dark red tumor size of cherry" | Hyperplasia |
| "Cyst size of hazel nut evacuated and removed" | Chordoma |
| "Soft grayish red mass" | Round-celled sarcoma |
| "Soft grayish mass" | Fibroma |
| "White tumor mass" | Adenoma |
| "Gray tumor size of cherry" | Adenoma |

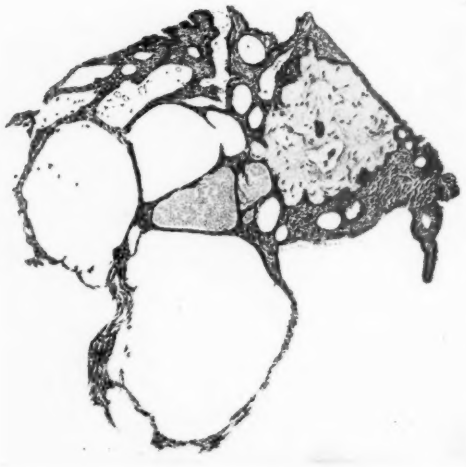

Fig. 3. Histological drawing from a sarcoma of the pituitary body, removed from a patient whose illness covered a period of at least two years. The growth was confined to the sella turcica, did not involve any adjacent structures nor did it give rise to metastasis.

Further obstacles are met in an attempt to draw deductions based upon the type of tumor, because of the difficulty in determining its precise nature. Thus, even with experienced pathologists, differences of opinion will be found as to whether a given tumor is an adenoma or a sarcoma, a benign adenoma or a malignant adenoma, an epithelial sarcoma or a carcinoma. In a report recently rendered upon one of my specimens it was stated that "there is undoubtedly an adenomatous condition here with grossly distended spaces lined with epithelial elements and filled with a faintly staining acid material, strongly suggesting the colloidal-like substance seen in hyperfunction. Added to this there are undoubtedly plugs of epithelial cells of the type of the glandular elements, together with some overgrowth of the connective-tissue cell elements. The diagnosis would, therefore, be adenoma with a possibility of adeno-carcinoma, though the latter diagnosis would be open to dispute."

As to the life history of these tumors, it is rather interesting to observe that even with those of a malignant nature there may be no evidences either of recurrence or metastasis for a number of years (Fig. 3). Quoting from the series of von Eiselsberg (loc. cit.), there was one case of adeno-carcinoma where even five and a half years after operation there was no evidence of recurrence, another of angiosarcoma with no evidence of recurrence four and one half years after operation, one of carcinoma in which over a year had elapsed, and one characterized as an epithelial tumor of a malignant nature where after two and one half years there were no signs of recurrence. While at the present time pathologists often disagree in their histological diagnosis, the fact remains that in its life history there is not the same distinction between the benign and the malignant tumor of the hypophysis as there is between similar lesions in other organs. Recognizing the many obstacles that arise in the surgical treatment of pituitary lesions, we have at least an encouraging feature in the fact that though the tissue removed may be malignant, the benefits derived from a given operation may continue over a number of years and this in face of the fact that in few, if any, operations has anything approaching a radical or complete removal been accomplished.

The size and the extent of the tumor is a matter of importance, more especially when we come to consider the question of approach and the manner of dealing with pituitary disorders on the operating table. The alteration in the conformation of the sella turcica as revealed by the radiograph is of great diagnostic value, and when the sella is much enlarged we can prognosticate in a measure as to the size of the tumor (Fig. 4). But, unfortunately, changes in the sella turcica are by no means always present, and whether small or large the tumor may extend upwards some distance from the floor of the sella in various directions. In none of the operations by the transphenoidal route can any exact estimate be made as to the extent of the lesion, although the same cannot be said of the transfrontal approach. In one operation by the transphenoidal method[1] it is recorded that a yellowish white tumor the size of a small nut was exposed and partially removed; at the autopsy twenty-four hours later the tumor was found to extend into the frontal lobe.

[1] Hochenegg. Deutsche Ztschr. f. Chir., 1909, c, 317–326.

The location of the hypophysis in relation to the tumor has been investigated in the hope of securing further data in the problem of how best to approach the hypophysis; that is, from the inferior or from the superior aspect of the tumor. Accurate descriptions of this relation in autopsy findings are somewhat meager, but several records have been found in which this relation is accurately described.[1] In these the relation is described somewhat as follows: The principal portion of the tumor was found in the sella turcica *over* the markedly flattened hypophysis, or the tumor had compressed and markedly flattened the hypophysis, or the hypophysis was flattened out against the wall of the sella turcica. From an investigation of available pathological records, one gets the impression that in the development of tumors of the hypophysis, the gland occupies a position on the floor or wall of the sella, and is not so much displaced upwards by the growth but rather flattened out against the floor of the sella. If the assumption be true, the hypophysis itself would be least subject to trauma if it were approached from the superior rather than the inferior aspect.

The observations already made, and about to be made, are based upon a careful analysis of the records and findings at 74 operations for pituitary lesions gathered from various sources. In this list only those cases are included in which the diagnosis was confirmed either at the operation or autopsy, and excludes cases in which the symptoms were due to tumors of adjacent structures not involving directly or primarily the pituitary body. The character of the lesion has been arranged in tabular form (Table I), and of the total number there were 14 cases of struma, 22 of adenomata, 6 of carcinoma, 10 of sarcoma, 11 of cysts or cystic tumors, 5 miscellaneous, and 4 not designated.

With this survey of the character of the lesion to be dealt with, we come to the phase of the subject that is of most concern to the surgeon. Under what circumstances shall we operate, and what is the most appropriate method of approaching and dealing with the lesion?

[1] Beitr. z. path. Anat. u. z. allg. Path., 1908, xliv, 233.

Fig. 4. Skiagraph taken of one patient in my series in which there was no unusual enlargement of the sella turcica. The operation revealed, however, a large cyst extending well beyond the confines of the sella. In this case, as in other cases, no estimation of the size of the tumor could be prognosticated from the radiograph.

TABLE I

| CHARACTER OF LESION | | |
|---|---|---|
| Hyperplasia | | 2 |
| Struma (chromophobe) | | 14 |
| Adenomata | 15 | |
| Cystic | 2 | |
| Papillary | 1 | |
| Malignant | 4 | 22 |
| Carcinoma | 1 | |
| Epithel-carcinoma | 1 | |
| Epithelioma | 1 | |
| Adeno-epithelioma | 1 | |
| Malignant tumor | 2 | 6 |
| Sarcoma | 4 | |
| Round-celled | 4 | |
| Perithelial | 1 | |
| Angio | 1 | 10 |
| Cysts | 8 | |
| Cystic tumors | 3 | 11 |
| Miscellaneous | | |
| Teratoma | 1 | |
| Mixed teratoma | 2 | |
| Chordoma | 1 | |
| Fibroma | 1 | 5 |
| Tumors (not designated) | | 4 |
| Total | | 74 |

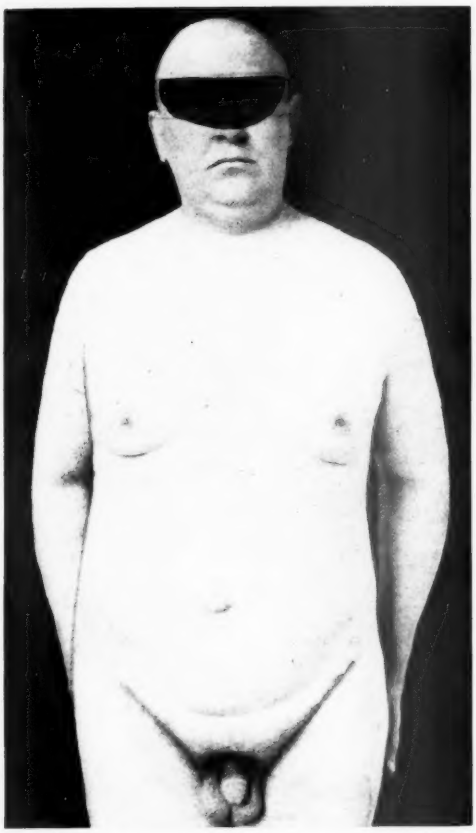

Fig. 5. Photograph of patient with actual acquisition of fat and sexual impotence. The operation upon this patient was performed not because of these symptoms alone, but for the relief of continuous headache and failing vision.

I should preface these remarks with the statement that the surgery of pituitary disease is still in the developmental stage, and that the opinion we may now entertain must be regarded as tentative and by no means final. There is still not enough data available to estimate with any degree of accuracy how long the improvement which follows operation in many instances will last. This is a phase of the subject which must be given consideration in formulating our views as to the indications for operation.

There are four features of pituitary disease for the relief of which operation might be considered: acromegaly, accession of fat and sexual impotence, disturbances of vision, and headache. In view of the gravity of the procedure, I doubt very much whether we are justified in operating solely for the purpose of arresting the changes of acromegaly. That is to say, unless there are other symptoms of a more distressing character, such as impending blindness and violent headache, we are scarcely justified in resorting to so formidable a procedure as an hypophysectomy. On the other hand, with the clinical triad of headache, impending blindness, and acromegaly, some means of intervention should be resorted to for the patient who seeks relief. The mere acquisition of fat with sexual impotence is another phase which of itself scarcely justifies resort to surgical therapy (Fig. 5), at least until the influence of glandular feeding has been given a thorough trial. The character of the operation selected to meet the various clinical syndromes will be discussed further on.

*Technique.* Where an exploratory operation is contemplated, the question at once arises as to the method of approach. By far the majority of operations have been performed by the transphenoidal route, 64 out of 74, but my experience with four operations for pituitary disease within the past year by the transfrontal route has lead me to adopt it as possessing certain points of superiority.

Krause[1] was the first to suggest approaching the hypophysis through the anterior cranial fossa; he resected the frontal bone and proceeded extradurally until the lesser wing of the sphenoid was reached; at this juncture the dura was incised and the hypophysis easily exposed. Borchard[2] tried to remove a hypophysial tumor by the above method, but was obliged to abandon the operation because of hæmorrhage. Kiliani[3] elaborated Krause's technique somewhat and advocated immediate incision of the dura. In 1911, Bogojawlensky[4] performed an operation through the anterior cranial fossa with satisfactory result, and in 1912 McArthur[5] elaborated a technique for the transfrontal route, the essential fea-

[1] Deutsche Klin., 1905, viii, 1004.
[2] Zentralbl. f. Chir., 1908, lxvi, 332.
[3] Ann. Surg., Phila., 1904, xl, 35.
[4] J. de Chir., April, 1912.
[5] J. Am. M. Ass., 1912, June 29.

ture of which was the temporary resection of the frontal fragment and a portion of the orbital roof.

*Technique of transfrontal approach.* The method which I have adopted is a modification of McArthur's, in that an osteoplastic flap is reflected and the segment resected is of smaller dimensions, consisting only of the supra-orbital ridge and a portion of the orbital roof. The following is a description of the various steps: Prior to the operation, the frontal sinuses are outlined by transillumination, as I have found this method more accurate than the stereoscopic radiograph. It is desirable, when possible, to avoid opening the sinuses, and if one is smaller than the other, this determines the side on which the operation is to be performed. In some instances, the sinuses on both sides are so large that one cannot avoid them, and while thus far it has not seemed to affect the process of repair and the "healing in" of the resected orbital segment, the presence of the open sinus seemed to me to be a potential source of infection. In one of my cases the sinuses were unusually large, communicating freely with each other, and extending outward as far as the external angular process (Fig. 6). At that stage of the operation in which the osteoplastic flap had been reflected and the supra-orbital ridge with the large sinus resected, I decided to proceed no further, restored the flap and fragment to their natural relations, and closed the wound. The wound healed without complications, the resected fragment became firmly attached to its adjacent surfaces, and later on I repeated the operation on the opposite side, exposed and removed a portion of an adenoma of the pituitary body.

Fig. 6. Radiograph showing the characteristic enlargement of the sella turcica and unusually large frontal sinuses which extend upwards as far as the external angular process.

The first limb of the incision begins at the external angular process (Fig. 7), follows the line and curve of the eyebrow to the median line at the root of the nose; the second extends from this point directly upward until a point is reached one inch within the hair line; the third continues within the hair line down to a point on the level with the external angular process. As a tourniquet cannot be used in this as in other craniotomies, hæmostasis must be effected with the aid of Allis forceps and hæmostats. The cutaneous margins are then reflected sufficiently to expose the cranium 2 cm. from the median line to avoid the pacchyonian bodies, and 2 cm. above the supra-orbital ridge. Two openings are made with the Hudson drill on either side of the base of the flap, and with the spiral osteotome the osteoplastic flap is freed and then reflected.

The supra-orbital ridge is then divided (Fig. 8), using a Hey's saw rather than a chisel or osteotome, as the former makes a very smooth, even section, to the outer side just within the external angular process and to the inner side at a distance of from 2 or 3 cm. from the median line, according to the outer limitation of the frontal sinus, both sections being made obliquely so that the resected portion is wedge-shaped (Fig. 9), and when replaced fits snugly in its place and cannot easily be depressed or dislodged when

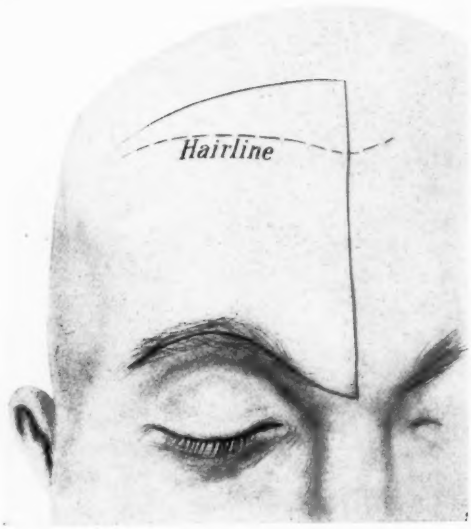


Fig. 7. Drawing showing the relation of the incision to the eyebrow and the hair line.

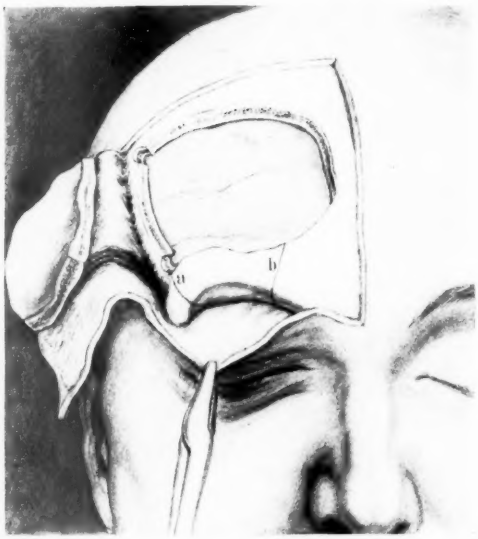


Fig. 8. Drawing showing the reflection of the osteoplastic flap and between lines (a) and (b) the portions of the supra-orbital ridge to be resected.

subjected to the pressure of the dressing and bandage. Thus, the contour of the supra-orbital ridge is perfectly restored. When the bone has been divided through the orbital ridge, it is grasped with a pair of sequestrum forceps and pried loose, carrying with it a portion, large or small, of the orbital roof. (This fragment is kept in normal salt solution at body temperature until the wound is to be closed.) The periosteum must then be separated from what remains of the orbital roof, and this must be done with great care and gentleness, since if torn, as it may readily be, the rent is difficult to close and further steps of the operation are hampered by the herniation of the orbital fat into the avenue of approach. After the periosteum has been freed, what remains of the orbital roof is removed with rongeur forceps down to, but not including, the margin of the optic foramen. The latter step is not necessary, and is more or less tedious in its execution.

At this stage, preparation is made to open the sella turcica. Earlier in the course of the operation a small opening is made in the dura in order to allow the cerebro-spinal fluid to escape freely and allow of greater displacement of the frontal lobe. With suitable retractors, the orbital contents are displaced downward and outward, and the frontal lobe elevated until a view is obtained of the optic nerve as it passes from the optic foramen to pass on toward the sella. The exposure of the optic nerve is essential as a guide to the next and important step, the incision in the dura (Fig. 10). The dura is incised in a horizontal direction about a centimeter above the base of the skull for a distance wide enough to admit of the blade of a retractor, and to expose the contents of the sella. The subsequent steps of the operation depend upon the character of the lesion to be dealt with.

*Comparison of methods.* When we compare the various methods of approach we must take into consideration that by the extracranial method most of the fatal issues have been due to meningitis, and while by the submucous resection of the septum the dangers of infection are minimized, the chances of infection through an avenue of approach as difficult to disinfect as the nasal cavities will always be greater than by any of the intracranial operations. Whether one uses the

Fig. 9. Fragment of bone including supra-orbital ridge and portion of orbital roof temporarily resected.

technique of Kanavel, Halstead, Cushing, or Hirsch, the difficulties of working in so contracted a space and the limited exposure of the field are serious obstacles, at least to the general surgeon. It seems to me of the extracranial methods that von Eiselsberg's technique is the most appealing, even though the cosmetic results are not as desirable, and von Eiselsberg's commentary on all the endonasal methods strikes me as very much to the point, when he says that it remains to be seen whether the intranasal procedures, which require the peculiar technical skill of the specialist, are to be left in the realm of the rhinologist rather than in that of the general surgeon. As a matter of fact, it remained for the specialist, Hirsch, to develop the technique of submucous resection, and to complete the operation without the use of a general anæsthetic. Again by the intracranial or transfrontal route, there is the advantage of being able to determine with a greater degree of accuracy the extent and operability of the growth. There are records of 12 cases in which the greater portion of the tumor was extra-sellar and encroached upon one or both of the cerebral hemispheres. Of sixty-four tumors operated upon by the extracranial method, there were twenty-four deaths, and the autopsy in twelve cases showed that the tumor extended some distance beyond the confines of the sella turcica. Whether these growths will prove to be operable remains to be seen. In none of the cases of my series have there been any of this character. While one should not lay too great stress on the cosmetic results when such grave symptoms can be alleviated as

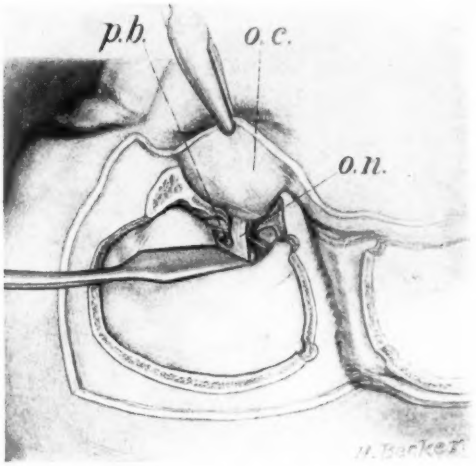


Fig. 10. With the head in the Rose position, after the supra-orbital ridge and what remains of the roof of the orbit have been removed, the frontal lobe is elevated with a retractor and the orbital contents are displaced downwards, exposing the optic nerve and immediately to the left of it, the pituitary body; o. c., orbital contents; p. b., pituitary body; o. n., optic nerve.

those accompanying hypophysial lesions, nevertheless, due consideration should be given to this phase of the subject in selecting the method of approach. I cannot but feel that the cosmetic effect of the transfrontal approach leaves nothing to be desired. After the lapse of a few months, I have found the scar in the median line is scarcely visible (Fig. 11).

*Indications for operation.* Leaving aside a discussion of the relative merits of the extracranial or intracranial procedures, consideration should be given to the special indications, if there be any, for purely palliative procedures, either by the so-called sella decompression or by the conventional temporal decompression. There are available in the 74 cases that form the basis of this review, records of 8 cases in which a temporal decompression was performed. In 3 instances no further intervention was resorted to, 2 of the patients living two months after the decompression with a very slight amelioration of the symptoms during the first part of the period; the other died in six hours from respiratory failure. The lesions as verified later by autopsy

Fig. 11. Photograph of patient taken a year after evacuation of a cyst of the hypophysis, showing the inconspicuous character of the scar after the transfrontal approach to the sella turcica.

were, respectively, teratoma, struma, round-celled sarcoma. In the other 5 instances, there was improvement in one case for 1 month, when a radical operation was performed and a cyst evacuated, in another there was slight improvement for 7 years at the end of which period a struma was partially removed by operation. In 3 cases no improvement followed temporal decompression. In one instance, it was both preceded and followed by a radical operation, at which a chromophobe struma was partially removed. In one case after the condition had remained unaltered for a month, it was followed by a radical operation and the evacuation of a cyst, after which latter procedure there was marked improvement — restoration of vision after almost complete blindness. In yet another instance, when two months after a radical operation and partial removal of struma no amelioration of the symptoms had taken place, a temporal decompression was resorted to, but to no avail. While no doubt temporal decompression will relieve for a while the symptoms of general intracranial tension, it will not prevent visual disturbances and ultimate blindness, nor can it influence the symptoms that arise from disturbance of the pituitary function. The scope of this operation is necessarily limited.

The mere removal of the floor of the sella turcica would seem to possess greater merit. If we assume at the outset that the great majority of pituitary lesions are inoperable from the surgical viewpoint, we must acknowledge that all the transphenoidal methods have at least this advantage to their credit, since, as von Eiselsberg says, their principal feature lies in the fact that we are able to establish a decompression and coincidentally remove a piece of the tumor or evacuate a cyst. I have been able to find only 3 instances in which sellar decompression was performed in this series of 74 cases, in which the lesion was verified either at operation or autopsy. Of these 3 cases, there was one case of acromegaly in which a sellar decompression was followed by slight improvement over a period of six months. A fragment of tissue removed at operation classed the lesion as a struma. In another instance, in which a fragment was removed at the time of the opening in the sellar floor, the condition remained unaltered during the four following months. The third case was followed by death in 24 hours, and a struma was reported by the histological examination. Sellar decompression may be indicated, as Schüller suggested, merely as a diagnostic measure, for even though there may be symptoms of glandular disturbance, these may be due to extra-hypophysial lesions, as in one of Hirsch's cases, in which there was a hydrocephalus and the hypophysis proved to be normal. In 4 cases in which the lesion has never been certified, slight amelioration of symptoms followed the sellar decompression for a period of from 5 months to one year. As a matter of fact, sellar decompression has not proven to have more than a very transitory influence on the course of the disease.

*Results of surgical therapy.* Taking our series of 74 operations of strictly pituitary lesions, what can be said of the effects of surgical therapy with or without glandular feeding? The results have been carefully analyzed from the standpoint of the pathological lesion, the clinical syndrome exhibited before the operation, and the character of the latter, as to immediate and ultimate effects.

First of all, with reference to the character of the lesion, the prognosis is most grave in the cases of sarcoma, and most favorable in the cases of cyst (Table II). Of 9 cases of sarcoma, in one there was temporary improvement, in one improvement continued over two years, and seven died. On the other hand, in eleven cases of cyst seven were improved and only three died.

The size of the lesion as well as its character influences the prognosis, as would appear from the fact that in 12 of the 24 deaths in 64 extracranial operations, the autopsy revealed an extensive growth beyond the sella turcica.

Of the total 74 operations by various operators, there were 29 deaths, a mortality of 39.1 per cent, but these figures do not give a fair estimate of what may be accomplished by individual surgeons who have had larger experience; thus, von Eiselsberg's mortality in 16 cases was 25 per cent., and Hirsch's in 14 cases, 21.4 per cent. In the 4 successive intracranial operations in my own series, there were no fatalities. Naturally in the developmental stage of any new surgical undertaking, the mortality will be high until experience, perfection in technique, and selection of cases combine to minimize the operative risks.

If we analyze the results of surgical interference according to the clinical syndrome, it appears that in 24 cases of the dystrophy group (adiposo-genitalis dystrophy), 15 were improved, 4 beyond the two-year limit, 1 temporarily improved with relapse, and 8 died. In this group there were:

| | |
|---|---|
| Struma | 7 cases |
| Adenomata | 5 cases |
| Cysts | 5 cases |
| Teratomata | 1 case |
| Sarcoma | 3 cases |
| Carcinoma | 3 cases |
| | 24 |

Fig. 12. Radiograph of patient showing the unusual widening of the sella turcica in a case in which the symptoms of hypophysial disease entirely disappeared after the administration of thyroid extract.

Similarly in the 26 cases of the acromegalic group, 14 were improved, one beyond the two-year limit, 1 unimproved, and 11 deaths. In this group there were:

| | |
|---|---|
| Hyperplasia | 2 cases |
| Struma | 3 cases |
| Adenomata | 11 cases |
| Sarcoma | 5 cases |
| Carcinoma | 2 cases |
| Cysts | 2 cases |
| Fibroma | 1 case |
| | 26 |

Of those exhibiting only symptoms of general intracranial tension, 13 were improved, 2 unimproved, and 9 died. Of these there were:

| | |
|---|---|
| Struma | 4 cases |
| Adenomata | 6 cases |
| Carcinoma | 1 case |
| Sarcoma | 2 cases |
| Cysts | 4 cases |
| Miscellaneous | 7 cases |
| | 24 |

Fig. 13. Photograph of patient, taken two weeks after operation by the author's transfrontal method of approaching the sella turcica.

The most instructive of our analytical tables is that which deals with the symptoms which responded in any way to surgical intervention. By far the largest percentage of improvements was noted, as one might expect, in the visual disturbance (28 in 74 cases), next in order was the relief of headache (18 in 74 cases); there were only 5 instances out of 23 in which adiposity was favorably influenced, and in but 8 in 26 cases of acromegaly were there evidences of improvement. The statistics must not be given too much weight in the final judgment of the accomplishments of surgery, since in many instances the reports were published but a few months after the operation was performed, and in certain instances the damage to the optic nerve was such that recovery of vision was out of the question. Furthermore, the estimation of the benefits of operation is not complete unless one takes into consideration the effects of the supplemental treatment by glandular feeding.

There are on record instances of the very positive influence of glandular feeding upon various symptoms. One of the most striking of these was in a case of a young woman whom I saw with Dr. G. E. de Schweinitz.[1] There was intense headache and nausea, enlargement of the sella turcica, cessation of menstruation, bitemporal hemianopsia, first for colors and later for form, followed by a gradual disappearance of the entire visual field, with total blindness of the right eye, lasting twelve days, and of the left eye lasting six weeks (Fig. 12). After months of treatment, there was complete restoration of vision as the result of the administration of large doses of thyroid extract, associated with inunctions of unguentum hydrargyrum. In my own series, there was one case in which after the partial removal of an adenoma, the administration of pituitary extract was followed by improvement in vision, relief of headache, and recovery of the sexual function. In another, after the partial removal of an adenoma, headache disappeared and the somnolence was very much less pronounced. As the optic nerves were already atrophied, restoration of vision was out of the question.

*Personal experience.* My experience with the radical operation for pituitary lesions has been limited to four cases. In each the sella turcica was approached by the intracranial (transfrontal) route.[2]

CASE 1. In one case of the dystrophic type (Fig. 11), a large pituitary cyst was readily exposed and evacuated. The convalescence was uneventful and there was improvement of the visual disturbance and headache.

CASE 2 was that of a middle-aged man who had many of the symptoms of hypoplasia of the gland, a moderate increase in weight, loss of hair and sexual function, headache and visual disturbance. The sella was filled with a mass, a portion of which was removed and proved on examination to be a struma (Fig. 13). Following the operation glandular feeding was instituted, and as a result of the combined effect, the headache, visual and sexual disturbances were favorably influenced.

CASE 3 as Case 4 exhibited only evidences of intracranial tension, although in both the pituitary body was the seat of a tumor, in one an adenoma, and in the other a sarcoma. In both, unfortunately,

[1] De Schweinitz and Holloway. J. Am. M. Ass., Sept. 21, 1912.

[2] I am indebted to Dr. Charles K. Mills, Dr. T. W. Weisenburg, and Dr. J. H. Lloyd, who will report these cases more fully, for the privilege of referring to them here.

the optic nerve was atrophied at the time of the operation. Glandular feeding was instituted in both. Somnolence was a conspicuous feature in one; the patient slept most of the time day and night, but since the operation he has been out of bed in daylight hours and intellectually is very much more alert. The fourth of the series is only in the convalescent stage and final report as to the effects of the operation must be held in abeyance (Fig. 14).

*Summary.* I have tried in this rather lengthy discussion to emphasize certain features which seem to me worthy of attention and consideration at this juncture in the development of pituitary surgery: the lack of unanimity of opinion as to the function of the pituitary gland as essential to life; the very variable clinical expressions of pituitary disease; the difficulty in the pathological classification of pituitary tumors, or in determining the extent or character of the lesion prior to operation; and more especially the relatively benignant character of tumors histologically malignant.

Fig. 14. Photograph taken during the convalescence of patient after the removal of sarcoma of the hypophysis by the transfrontal approach. The contour of the supra-orbital ridge has been fully restored and the scar is scarcely visible.

TABLE II

| | Total | Improved | Unimproved | Death | Temporary improvement | Final improvement |
|---|---|---|---|---|---|---|
| Hyperplasia | 2 | 1 | .. | 1 | .. | .. |
| Struma | 14 | 9 | 2 | 2 | 1 | .. |
| Adenomata | 22 | 12 | .. | 8 | 1 | 1 |
| Carcinoma | 6 | 1 | .. | 3 | .. | 2 |
| Sarcoma | 10 | 2 | .. | 7 | .. | 1 |
| Cysts | 11 | 7 | .. | 3 | .. | 1 |
| Teratoma | 3 | 1 | .. | 2 | .. | .. |
| Chordoma | 1 | .. | .. | 1 | .. | .. |
| Fibroma | 1 | .. | .. | 1 | .. | .. |
| Tumors | 4 | 3 | .. | 1 | .. | .. |
| | 74 | 36 | 2 | 29 | 2 | 5 |

TABLE III

| | Total | Extracranial | Intracranial | Temporal Decompression |
|---|---|---|---|---|
| Temporary improvement | 36 | 31 | 5 | .. |
| Unimproved | 2 | 2 | .. | .. |
| Death | 29 | 24 | 2 | 3 |
| Improvement ff. by relapse | 2 | 2 | .. | .. |
| Improvement beyond 2 years | 5 | 5 | .. | .. |
| | 74 | 64 | 7 | 3 |

TABLE IV

SYMPTOMS RELIEVED BY OPERATION

| | Adiposity | Acromegalic Changes | Visual Disturbances | Headache | Mental Disturbances |
|---|---|---|---|---|---|
| Dystrophy group (24) | 5 | .. | 11 | 7 | 1 |
| Acromegaly group (26) | .. | 8 | 8 | 4 | 1 |
| Intracranial tension (24) | .. | .. | 9 | 7 | 2 |
| | 5 | 8 | 28 | 18 | 4 |

TABLE V

CHARACTER OF LESION IN CASES CLASSIFIED ACCORDING TO CLINICAL SYNDROME

| | Dystrophy | Acromegaly | Intracrania Tension | Total |
|---|---|---|---|---|
| Struma | 7 | 3 | 4 | 14 |
| Hyperplasia | .. | 2 | .. | 2 |
| Adenomata | 5 | 11 | 6 | 22 |
| Sarcoma | 3 | 5 | 2 | 10 |
| Carcinoma | 3 | 2 | 1 | 6 |
| Cysts | 5 | 2 | 4 | 11 |
| Miscellaneous | 1 | 1 | 7 | 9 |
| | 24 | 26 | 24 | 74 |

I must concede to surgery as yet a comparatively limited field in the treatment of pituitary disorders. Glandular therapy, including the use of both thyroid and pituitary extracts, should be given a fair trial, at least until vision is threatened or the progress of the disease has proved to be uninfluenced. There does not seem to be any future for purely palliative procedures, particularly temporal decompression, and if operation is to be resorted to, it should consist in an attempt at the removal of a considerable portion of the tumor. There are well substantiated records to show that in the accomplishment of this, the beneficial effects of the operation may extend over a period of at least five years. There is little evidence yet to show that the operation will be followed by a complete retrogression of the effects of perverted tissue metabolism, although they may be arrested and other subjective symptoms, such as headache, impending blindness, somnolence, and psychic disorders, relieved. Therefore, operation should not be delayed too long. As to the choice of procedures, I advocate the intracranial transfrontal method as being freer from the risk of infection, affording a better exposure, and better adapted to the gross pathological relations of the lesion.

# THE PROBLEM OF INTESTINAL STASIS[1]

By A. E. ROCKEY, M. D., Portland, Oregon

CAREFUL clinical observation is convincing me, day by day, that the question of intestinal stasis and its consequent morbidity is one of the most important subjects before the medical profession at this time. Constipation in greater or less degree afflicts a surprisingly large number of people. In some its results appear to be trivial, but in a considerable number it is a definite cause for occasional or chronic illness.

The large intestine is a reservoir for the fæces. The contents of the small intestine are liquid. In their passage through the large intestine much of the liquid is absorbed. The most important part of digestion and assimilation has taken place in the stomach and small intestine. The residue which is poured into the large intestine for storage and further concentration, is of minor value in nutrition. The longer the contents of the large intestine are delayed in their evacuation, the more they are subject to bacterial decompositions. Some of these may be harmless, but some are harmful by the production of noxious toxins, which are absorbed along with the liquid portion of the fæces. By reason of its size, length, and structure, the large intestine is adapted to retain the fæcal contents for a considerable period of time, and its evacuation is largely under control of the will. There are certain variations of form and position which tend to prolong the period of evacuation. These variations are congenital or acquired. The congenital variations have been quite fully described by Huntington, and the acquired variations by Glennard, Lane, and Jackson. The most common variation is midline ptosis. I shall not at this time discuss the causes of ptosis.

As to the symptoms of ptosis, they may be considered in two classes: First, the pain and other symptoms of the ptosis itself; and second, the symptoms of stasis. The symptoms of gastric stasis I shall not enlarge on here. The symptoms of intestinal stasis, aside from constipation and discomfort, are the symptoms of autointoxication from the pernicious intestinal absorption.

Ptosis is undoubtedly a cause of stasis in many cases, and stasis by its interference with nutrition and by its mechanical elongation of the colon, is probably a frequent cause of ptosis. But ptosis is found without stasis, and stasis is found without ptosis.

Stasis does not necessarily mean constipation. There are a few cases of marked intestinal autointoxication without constipation, and there are many cases of constipation where the autointoxication is only occasional and transient. Such apparently paradoxical cases are illustrated by Figs. 3 and 20.

Cases in which autointoxication with constipation persists in spite of medical and dietetic treatment are commonly cases for surgical treatment. The cases in which constipation exists without autointoxication are as a rule cases that are curable by medical and dietetic treatment.

The treatment of ptosis and stasis is prophylactic, hygienic, dietetic, medicinal, mechanical and surgical.

The surgical treatment of ptosis is the fastening up of prolapsed viscera.

Many symptoms, both gastric and intestinal, ascribed to ptosis, are symptoms of stasis, and clear up when the stasis is relieved, and do not necessarily clear up when the ptosis is relieved, or especially when attempts are made to relieve it.

The surgical treatment of intestinal stasis is the anastomosing of the lower end of the ileum with the upper end of the rectum, the "short-circuit" operation of Lane.

When Metschnikoff announced that senility was due to the toxic effect of the absorption of the products of pernicious decomposition in the colon, his opinion was received with a generous smile. No less startling had been his previous discovery of the phagocytic power of the leucocytes. That also had been received at first with a considerable degree of incredulity. It was, however, so speedily

[1] Read by invitation before the annual meeting of the Southern Oregon Medical Society at Grant's Pass, Oregon, May 13, 1913.

confirmed by many other investigators that clinicians welcome it as explaining the phenomena of leucocytosis in acute infective conditions. An important function of the phagocyte is to remove dead cells of the body tissue. Whether these cells are destroyed by trauma or the results of infection, it is the leucocytes that act as scavengers to clear away the débris. The necrosis produced by infection is the result of the toxins developed by pathogenic bacteria. The infection is virulent only by reason of the destructive effect of these toxins. With pathogenic bacteria these tissue necrosis effects in the acute infections are local and general. Tissue necrosis takes place in the immediate vicinity of the infection. The remote constitutional effects may be manifest as nephritis or general tissue debility. Metschnikoff explains some cases of deafness by saying that intestinal toxins destroy parts of the auditory apparatus, and then the phagocytes remove it.

There are some other toxins whose remote effects in producing tissue necrosis are more marked. Post-diphtheritic lesions are good examples. Here the focus of infection may be limited to the throat, or in the case of experimental diphtheria in a guinea pig or rabbit, to a zone in the immediate vicinity of the site of innoculation. The remote effects, however, are seen in necrotic and hæmorrhagic patches on the liver or on the sheaths of the nerves. In a measure the tissues frequently show a selective action for certain poisons. The action of wood alcohol on the optic nerve will illustrate this. These remote destructions of tissue are sudden or slow in proportion to the virulence and dose of the toxin. In diphtheria or wood alcohol they are sudden. In chronic suppuration or in lead poisoning they are slow.

Exactly similar is the poisoning from intestinal autointoxication. It may be acute in both its local or constitutional effects; for example, in an acute cholera morbus, or in that symptom complex popularly designated as a bilious attack. These conditions are transitory, and the system quickly recovers. Not so, however, when the disorder is dependent on continuous autointoxication. The result is a chronic autointoxication with destructive effects on the tissues, which, though vastly more varied, are as definite as those of chronic lead poisoning.

It will suffice to call your attention in detail to a few of the remote constitutional effects now fairly attributable to chronic intestinal autointoxication. Prominent among these are nutritional disturbances. An early result is loss of appetite, poor digestion with a consequent loss of weight, poor circulation, cold hands and feet, nervousness, restless sleep, a marked tendency to localized pains in various parts of the body, sallow complexion, and a general decline of health. Localized changes in the tissues may now follow. Nephritis, hepatic cirrhosis, myocarditis, arteriosclerosis, rheumatoid arthritis and the like, have been so frequently mentioned that it is scarcely necessary to repeat the list. Enlargement of the thyroid gland is not rare in this class of patients. This may be either cystic or of the exophthalmic type. Lane has called attention to the frequency of cystic degenerations in the breasts of women of this type, and I have been able in a number of instances to confirm his observations. He also considers duodenal ulcer an occasional sequence of stasis. Startling as this claim is, I am beginning to believe it. Within the past year I have operated on several cases of acute perforating duodenal ulcer, and invariably they gave a history of chronic constipation.

One of these, a man 27 years of age and in general good health, though slender in build, ate a hearty breakfast and then went to his usual work. At ten o'clock he was seized with a violent abdominal pain. The obvious remedy, a large drink of whiskey, was kindly administered by a neighbor, into whose house he was taken. A physician was called, who promptly diagnosed the perforation, and brought him to me at the hospital. At operation a small perforation was found in the first portion of the duodenum. This was stitched, and the abdomen cleansed with moist sponges. While doing this I found that the colon was very much elongated. The transverse colon could easily be drawn to the pelvis. The sigmoid was so long that I was able to bring the loose loop through the incision onto the lower part of the sternum. The abdomen was closed without drainage. The case being an acute one, no history of the previous condition had been taken, but I remarked to those present that the case was undoubtedly one of extreme constipation. This we found had been the case for some years. He is now taking a daily

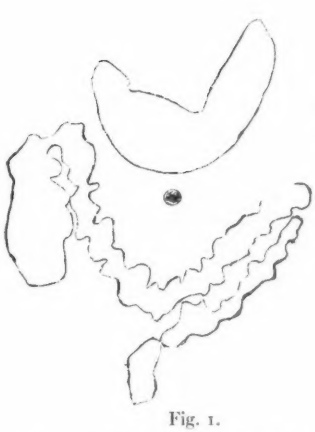

Fig. 1.

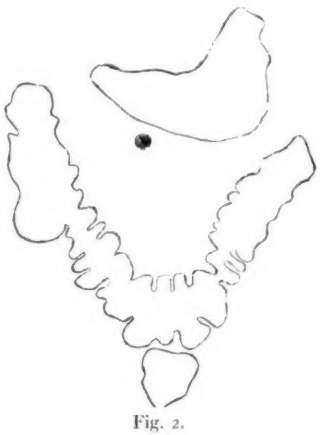

Fig. 2.

Fig. 3.

Fig. 1. Mrs. B, age 57. Chronic constipation with autointoxication. Extreme nervousness.

Fig. 2. Mrs. W., age 37. Chronic constipation; thin, weak and nervous.

Fig. 3. Mr. Y., age 37. Height 6 feet, weight 121½ pounds. Rheumatoid arthritis of severe type for seven years. Bowels regular. Lane's short-circuit operation done April 16th. Speedy relief of pain in joints, improvement in appetite and gain in weight.

dose of liquid paraffine for the relief of his constipation, and presently we may short-circuit his colon to cure him.

In the study of intestinal stasis we have to deal both with the clinical and physical side of the condition. A careful consideration of the history of the patient is of the highest importance. That usually begins with occasional constipation, finally becoming obstinate, then possibly alternating with diarrhœas. Laxative-taking in a general way for a greater or less period of time usually precedes the first consultation with a physician. Then comes the hygienic advice, more water drinking, and eating of fruits and bulky succulent vegetables, and often times more laxatives. Many times such treatment is successful in curing the patient, but oftentimes it results simply in relief, the continuance of which depends upon the continuance of the remedies. Family history often reveals similar cases in relatives and ancestors. The intensity of the result of autointoxication depends oftentimes on the constitutional condition of the patient. Persons of feeble constitution often follow the downward path of chronic indigestion, autointoxication, declining health, and premature senility. There are many curves in this path due to the greater or less efficiency of the methods used to combat the tendency. Proper hygienic and medicinal measures are certainly of great value, and it cannot be denied that many absolute cures are made in this way. It must also be agreed that many cases are not cured.

The local conditions vary much with the cause of stasis. Ptosis may be general, as in the extreme form described by Glennard, or it may be a midline ptosis, in which both the stomach and colon are prolapsed in the center, the side supports remaining. In many cases, however, as the illustrations herewith presented show, the stomach retains its position, and the colon alone is prolapsed (Figs. 1, 2, 8 and 13). Ptosis is by no means a universal accompaniment of stasis. There are many cases of extreme and persistent stasis with only a moderate amount of ptosis.

Fig. 20 illustrates a case of prolonged constipation of a severe type without ptosis. This condition has existed for at least 25 years. The patient is 38 years of age. An interesting feature of this case, not, however, connected with her constipation, is that the woman has never menstruated. She has been married 15 years. Her nutrition is good, and the abdomen rather fat. For this reason pelvic examination is not easy. The lower part of the uterus can be palpated, but it is impossible to state definitely whether ovaries are present. Uterine sound enters only 1½ inches. Although the lower part of the canal is sufficiently patulous to admit the sound easily, it then meets a firm resistance, which seems

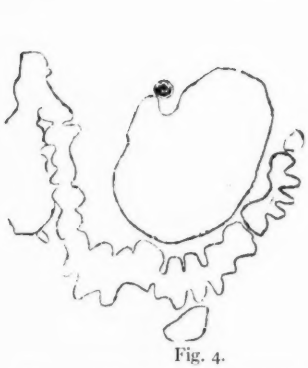

Fig. 4.

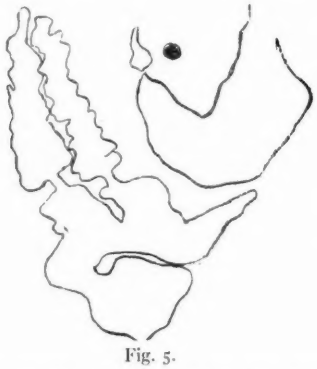

Fig. 5.

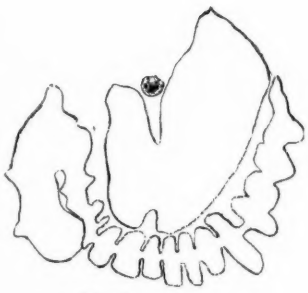

Fig. 6.

Fig. 4. Mrs. S., age 35, weight 94¾ pounds. Pain lower left quadrant for years. Moderate constipation. Chronic invalid.

Fig. 5. Mrs. T., age 25, weight 109 pounds. Constipation for four years. Severe autointoxication. Lane's short-circuit operation. Cured.

Fig. 6. Mrs. G., age 56. Chronic constipation. Arthritis sciatica. Invalidism.

to indicate either complete stenosis or the end of a small uterus. The history is one of occasional attacks of transient autointoxication. The plate is reproduced for the purpose of showing that severe constipation may exist with a high position of the abdominal viscera, and with but slight constitutional disturbance.

Stasis may be due to the inhibition of the peristaltic action of the intestines by chronic inflammatory conditions within the abdomen, particularly of those of the gall-bladder or appendix. It may also be caused by the adhesions which have formed as a result of acute inflammatory attacks. This is particularly true of the appendix, but also does not infrequently result from acute inflammatory disease of the uterine appendages when extensive intestinal adhesions have followed.

Some cases of stasis have been cured by the surgical relief of the ptosis, but such operations are by no means a panacea, and failure has frequently followed an attempt to cure in this way. The reason for this must be evident when we examine X-ray pictures of the bismuth meal, and see, as may be seen in the illustrations, that there are many cases of obstinate stasis with the stomach in a high position, and some cases with both the stomach and colon in normal positions, and also a considerable number of cases exhibiting a marked ptosis without stasis.

Fig. 3 illustrates the case of a man 37 years of age, 6 feet tall, and weighing in ordinary street costume but 121½ pounds. He has daily movements of the bowels, and his urine contains only a trace of indican; but for the past seven years he has suffered from rheumatoid arthritis, that has now produced a considerable deformity of the joints and atrophy of the muscles. For the past two years he has been a confirmed invalid, suffering at times great pain. His appetite was poor, and his mental condition one of extreme dejection, approaching melancholia. Two months ago I performed Lane's short-circuit operation, and the most marvelous improvement has resulted. The pain has disappeared from his joints; the mobility has increased to the limit of the anatomical changes that had before existed; his appetite has become almost ravenous; and his mental condition is one of constant good cheer. If not to the short-circuiting of his colon, to what other cause can this great change be attributed when his disease had defied all previous treatment. The plate is presented as showing that regular movements of the bowels may exist in the presence of marked ptosis; and yet within the colon existed some condition that was producing rheumatoid arthritis.

So common is the downward midline curve that the time has come to question our ideas of what constitutes normal position of the stomach and colon. The drawings of the anatomists are made from the cadaver, and illustrate the ordinary position of the organs in recumbent posture after death. The radiograph of the bismuth meal has taught us, however, that the extremely high position which we see illustrated in the books, and which we have been taught to consider as normal, may be the exception rather than the rule. By the data we have accumulated

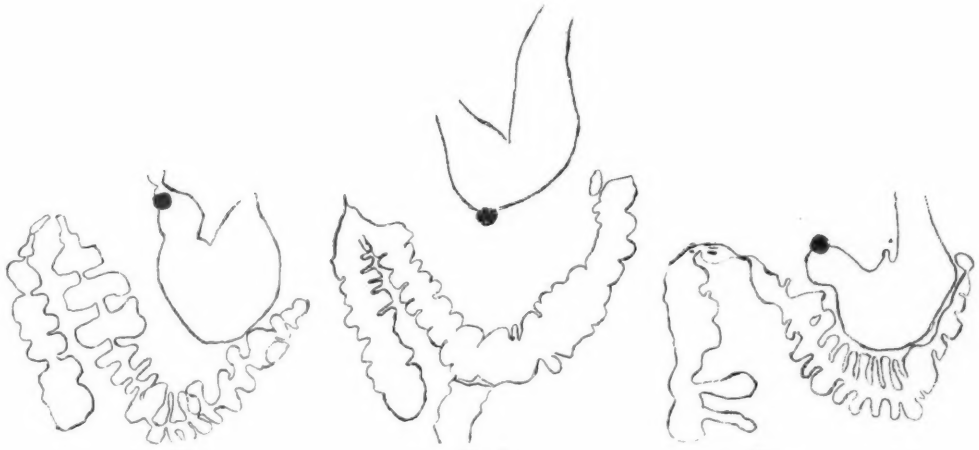

Fig. 7. Fig. 8. Fig. 9.

Fig. 7. Miss S., age 33. Constipated for years. Declining health. Lane's short-circuit operation recommended.

Fig. 8. Miss S., age 30. Severe constipation. Mucus in stools. Pain left upper quadrant. Autointoxication well marked.

Fig. 9. Mrs. F., age 30. Operated for acute appendicitis nine years ago. Frequent severe pain in right lower quadrant since that time. Constipated.

through the examination of X-ray pictures of bismuth meals, even though an undue proportion of these may be of ptosis cases, we must consider that a moderate ptosis may exist without in any way seeming to be detrimental to the general health, and may be a normal rather than pathological condition. Midline ptosis of an extreme degree, while favoring stasis, does by no means universally produce it, and stasis, even of a severe type with all of the malevolent effects of autointoxication, may exist without ptosis.

Constipation may in the beginning be functional, and due to the personal habits of the individual. He is negligent to nature's calls. His hygiene is bad, particularly in taking an insufficient amount of fluid. The results are constipation, for the temporary relief of which laxatives are resorted to. The intestine, accustomed to this stimulant, fails to respond to the ordinary stimulus, and stasis results. Accumulations in the colon tend rapidly to produce not only a constitutional autointoxication, but local irritation in the colon itself. By contiguity of structure this inflammatory condition extends through the walls of the colon, and a pericolitis develops. This results in the throwing out of plastic material, and the formation of pericolonic adhesions. These are at first fine and soft, but eventually become well organized, and have definitely developed blood vessels. They serve in a measure to prevent further descent of the viscera, but these adhesions are not always well placed for this purpose. They often produce kinks, and add to rather than relieve the existing stasis. These are the acquired mesenteries of Lane. He considers them due to the tension caused by the downward pull of the viscera—the "crystalization of the lines of force." It is indeed quite within reason to believe that the stimulus produced by undue tension might produce a reaction resulting in cell proliferation, and that their development might be largely due to mechanical action rather than to plastic exudate produced by toxic absorption. They do not by any means exist in all cases of pronounced intestinal stasis or ptosis, but they are to be found in a considerable number. Lane has called attention to the manner in which such adhesions may produce sharp kinks in the appendix, and thus may be the cause and not the result of either chronic or acute appendicitis. This may explain also the reason of the frequent failure to cure gas-

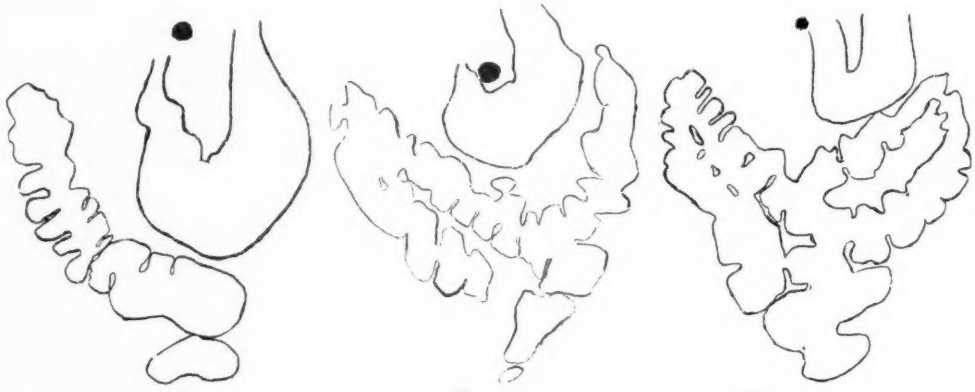

Fig. 10. Fig. 11. Fig. 12.

Fig. 10. Mrs. C. Severely constipated for years. Several attacks of obstipation that closely simulated ileus. Lane's short-circuit operation. Cured. Gain of 18 pounds in three months.

Fig. 11. Mrs. V., age 38. Severely constipated for years. Lane's short-circuit operation. Cured. Gain of 30 pounds in five months.

Fig. 12. Mrs. B., age 40. Many years of constipation and autointoxication. Invalidism. Lane's short-circuit operation. Cured.

tric symptoms by the removal of an appendix of this type. The so-called chronic appendicitis, which it is here admitted is an actual entity in some cases, is in other cases a part of the disturbances that result from stasis, and not the primary cause of it. Where the so-called chronic appendicitis is a secondary result of stasis, the sharp kinks observed by Lane will be found. The proximal portion between the first kink and the cæcum will be found normal, but the distal portion may be either dilated and contain mucus, or may be the seat of a more or less chronic or acute inflammation. The formation of enteroliths beyond this point, with their consequent pressure necrosis and acute inflammation, are then a secondary result of the pericolitis produced by the stasis.

Indican in great excess appears in the urine of many patients in whom autointoxication is well marked. This substance has received attention chiefly on account of the ease with which it is detected by a vivid color reaction. More careful examinations, however, have shown that indican is only one of a group of toxic substances which are absorbed from the intestinal tract in stasis cases, and produce by their constant presence detrimental effects upon the tissues. It must be considered as the flag of the enemy rather than the whole army, and its elimination from the system before absorption takes place must be regarded as securing elimination of other toxic substances which go with it. Whether this be accomplished by improved hygiene, or by facilitating the movement of the intestinal contents by the mechanical device of Lane's short-circuit operation, the protection of the system is assured, and improvement of the patient's condition follows. The frequent appearance of excess of indican in the urine must be regarded as significant, particularly so when it is associated with constipation and general abdominal pain, symptoms which frequently indicate the development of chronic pericolitis, which results in the formation of adhesions and the development of the symptom complex, commonly attributed to intestinal indigestion. Persistent indicanuria is sometimes observed in lesions of the mucosa of the gastro-intestinal tract, as in gastric or duodenal ulcer, or chronic appendicitis, diverticulitis, or in neoplasms of the large intestine. Any of these may, however, be secondary results of stasis. It is quite certain also that the frequent appearance of an excess of indican antedates the occurrence of the actual lesion. It accompanies the primary irritation on which the lesion forms.

The position, form, and time of passage can

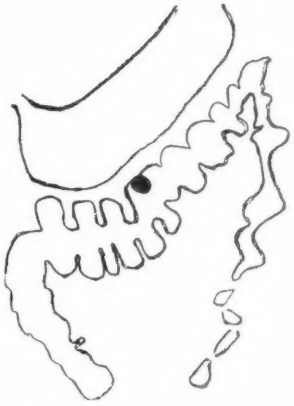

Fig. 13.

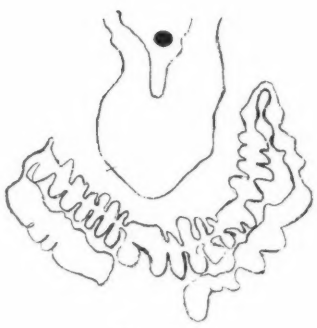

Fig. 14.

Fig. 15.

Fig. 13. Mr. J., age 40. Constipated six years. Lane's short-circuit operation. Cured.

Fig. 14. Mrs. B., age 42. Alternating diarrhœa and constipation. Autointoxication.

Fig. 15. Mrs. K. Weight 94. Age 41. Severe vomiting and constipation. Autointoxication. Lane's short-circuit operation. Cured.

readily be ascertained by the radiographic examination of the bismuth meal, either by the screen or plates. In plate examinations of stasis cases, a large dose is given, and twenty-four hours later, before the picture is taken, a smaller dose given. The outline of both stomach and colon is then taken on one plate.

The tracings which I show you are enlarged by placing a net of squares in front of the plates in the illuminator, and drawing the pictures over similar squares ruled by fine lines on the paper. This method gives a definite accuracy, so that the outlines here shown represent the shadows produced by the bismuth on the plates. The distribution is at times exceedingly peculiar, and sometimes requires an understanding interpretation, though in the main they definitely show the position, size, and shape of both the stomach and colon.

It may be well for us to consider the clinical side of this subject as emphasizing our idea of the theoretical side.

Fig. 11 illustrates the case of a woman 38 years of age, who had for many years been a sufferer from a most obstinate type of constipation. Enormous doses of laxatives were constantly required. In addition to this she was obliged to resort to enemas, very commonly in the lying position. A considerable portion of her time each day was given to securing a movement of the bowels. This was necessary in order to keep her in any degree of health and comfort. In spite of this she declined steadily in health until finally secondary vomiting supervened. Before she came under my care vomiting had been frequent, indeed almost constant, for a period of six weeks. When the picture I show you was made, she was so weak that it was with difficulty that she could stand long enough to have the plate holder adjusted and the exposure made. After the picture was made she was sent to the hospital, and as the frequent vomiting had so much reduced the fluids in her tissues, it was deemed best to endeavor to improve her condition. This was done by raising the foot of the bed about ten inches and administering a sugar solution per rectum by the drop method. The solution we commonly use is a tablespoon of ordinary cane sugar to a quart of water. This is the routine direction given to the nurses in the hospital, and is more convenient than drachms and ounces. I may say in passing that the use of this solution, suggested by my associate, Dr. Barbee, has in my practice almost entirely displaced the use of salt solution by the drip method in all post-operative cases. In the case under consideration this was continued several days. Lane's short-circuit operation was then done, and the result has been highly satisfactory, and I may even say spectacular in the manner in which the patient has been changed to a healthy, even robust woman. She now has daily movements of the bowels, and from the time of the operation to the present has not taken a single dose of medicine. The operation was done last September, and by April 9th of this year a gain of thirty-five pounds in weight had been noted. There has been a corresponding improvement in her color and in general demeanor. In other words, her life has been entirely changed.

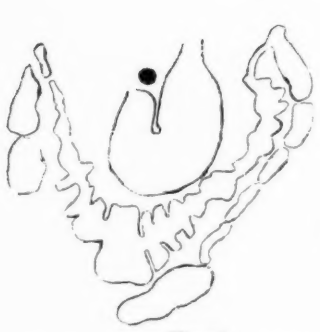

Fig. 16.

Fig. 16. Mrs. L., age 65. Weight 105 lbs. Stomach trouble since aged fifteen. No constipation. No stasis. Pain left abdomen, especially after meals. Frequent vomiting which relieves pain. Greatly improved and gained weight by abdominal support, feeding and rest after meals. A case of ptosis without stasis.

Fig. 17.

Fig. 17. Mrs. Mc., age 45. Always constipated. Autointoxication.

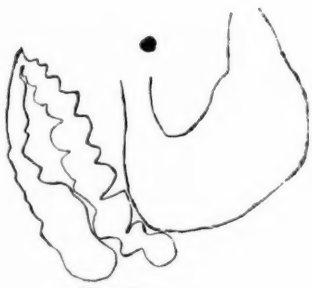

Fig. 18.

Fig. 18. Mrs. C. Severe constipation and gastric disturbances. Autointoxication.

Fig. 10, Mrs. C. You will note here, in addition to the ptosis of the colon, a considerable ptosis of the stomach, and it is distinctly a midline ptosis. The stomach falls into a rather sharp bend in the midline, and it must be evident that in passing out from the pylorus a decided upward movement of the gastric contents must be secured if the patient is in the upright posture. In this case, however, it was the intestinal symptoms that were the most prominent. Obstinate constipation with an extreme degree of autointoxication was present. Bad color, sunken eyes and face, and general appearance of invalidism was present. The constipation became a severe obstipation, and on two occasions the attending physicians were about to advise an abdominal operation for acute intestinal obstruction, when further persistence with the use of castor oil and enemas succeeded in moving the bowels. It was just after the second of these attacks that the patient came under my care, and I at once advised a Lane short-circuit operation. At operation we found the typical acquired mesenteries which Lane describes. The results of the short-circuit operation were as marked as those of the previous case. An entire change in the condition of the patient has resulted. This patient lives in a neighboring town, and I have seen her but once since she left the hospital. On that occasion, about three months after the operation, she had made a gain of 18 pounds in weight. There were daily movements of the bowels, her color had changed from a sallow cachetic to a healthy pink, and her expression to one which indicated well the full joy of living which she now felt.

Fig. 13, Mr. J., is from a patient presenting the following history: Age 40, severely constipated for eight years, then followed by a period of three years of comparative freedom from constipation and much improvement in health, and then again constipation of a severer type for eight months, during which he had been reduced to a condition of invalidism. He had not been able to do any work. Lane's short-circuit operation was done on this man on the occasion of a recent visit of Dr. Yocum. At operation we found the cæcum firmly adherent just below the brim of the pelvis. The appendix had rather a sharp kink, but the adhesions seemed to be more retrocæcal than as though they had been caused by an acute appendicitis. So firmly was the cæcum bound down that the section across the ileum was made nearly an inch further than usual from the ileocæcal valve, in order to get proper working room. From the time the rectal tube was removed, six days after the operation, to the present time, this patient has had daily movements of the bowels. Although scarcely two months have passed he has made a most rapid improvement in general health. His appetite has become almost ravenous, and the stomach has proved its good condition by promptly taking care of all that is put into it.

Another case, of which we have no picture, illustrates a most interesting case of chronic invalidism due to an intestinal stasis and autointoxication. This woman had in addition to her constipation much pelvic pain, probably produced by a chronic salpingitis. For this several years ago an operation was performed, and the right ovary and tube removed. A ventral hernia followed this operation, and her condition was worse than before. The constipation was varied by the occasional occurrence of diarrhœa, and at all times there was an excessively large quantity of mucus in the stools. Eight months ago appendicostomy was done by one of my colleagues on this patient for the purpose of curing a chronic colitis by colonic irrigation. An operation was also done for her ventral hernia. This unfortunately failed, and the hernia recurred. The appendicostomy, however, was successful in enabling her to flush out her bowels. By doing this from one

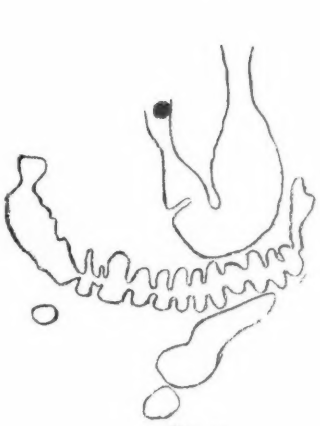

Fig. 19.

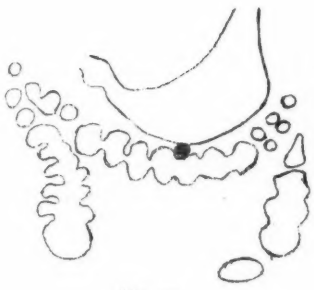

Fig. 20.

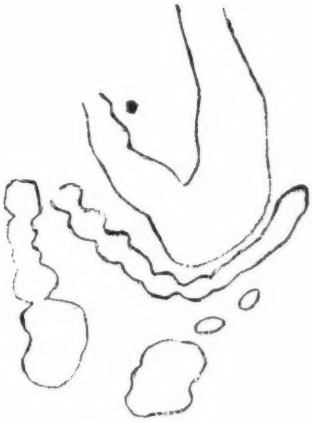

Fig. 22.

Fig. 19. Mr. D., age 32. Chronic constipation and dyspepsia for 17 years. Appendectomy six months ago without relief. Autointoxication. Invalidism.

Fig. 20. Mrs. S., age 37. Constipation for 25 years. Occasional attacks of acute autointoxication.

Fig. 22. Mrs. S. Obstinate stasis. Not relieved by medical treatment, massage, hydropathic treatment including a course of olive oil injections. Lane's short-circuit operation has made a complete cure.

to three times a day, during the eight months before she came under my care, she was able to keep in a condition of tolerable comfort. It is interesting to us to know that in spite of this long-continued irrigation there had been no relief from the mucus colitis. In this condition the patient came under my care. A stool which I examined contained the customary long strings of mucus in great abundance. In addition to her extreme stasis and autointoxication, she had deep cervical and perineal lacerations, and evident pelvic disease in the left side. At the same operation I amputated her cervix, which was the site of most extensive cystic degenerations engrafted on a very deep bilateral laceration, and repaired her perineum. I then opened her abdomen, and found a large hydrosalpinx of the left tube. This was opened. The left ovary, the one remaining, contained a cyst the size of an egg. This was opened, and the lining membrane removed. Lane's short-circuit operation was then done, and her ventral hernia repaired. From the time of the removal of the rectal tube, six days post-operative, to the present she has had regular movements of the bowels, more frequent than normal at first, but now two months after the operation entirely normal. The autointoxication symptoms have already entirely disappeared. She has been speedily restored to good health by operation, when complete colonic flushing from one to three times a day for eight months had failed.

Fig 22 illustrates a case, showing conclusively the failure of most thorough medicinal treatment and irrigations of all sorts to cure an obstinate stasis, that was promptly cured by a short-circuit operation. The patient is the wife of a physician, who is superintendent of a sanitarium, and has had much hydropathic treatment and massage. This included a course of olive oil injections given in the knee chest position. By constant use of such treatment she was barely able to keep out of the invalid class, and at the slightest remission suffered much from autointoxication. Lane's short-circuit operation has made a complete cure.

Fig. 15, Mrs. K. This illustrates a typical case of midline ptosis. The gastric symptoms were

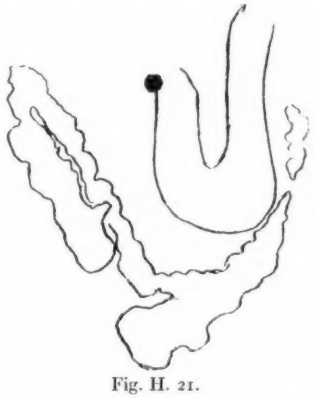

Fig. H. 21.

Fig. H. 21. Mrs. B. Invalid for six years from intestinal stasis. Patient of Dr. F. L. Horsfall. Lane's short-circuit operation done at Seattle General Hospital, April 8th, before the members of the King County Medical Society. Complete recovery. The patient now has two bowel movements daily.

marked by frequent attacks of vomiting. Malnutrition was pronounced, her weight being but 94 pounds. Constipation had been severe for years, and the usual autointoxication symptoms were present. Lane's short-circuit operation promptly restored this patient to health.

Fig. 12 is a case that is interesting in that it exhibited for many years an extreme degree of constipation and irritability of the stomach, in addition to the usual autointoxication symptoms and chronic invalidism. She is the wife of a physician, and had not only the constant counsel and advice of her husband, a most successful practitioner, but the advice of his many medical friends, among them being men of national reputation. Three years ago her appendix was removed at a celebrated clinic for chronic appendicitis. It was the site of lesions such as I have described, which are due to the secondary kinks formed by the acquired mesenteries of Lane. There was no relief from the operation. The symptoms increased in severity until her husband gave up his practice and went with her to southern California for her health. After some months in San Diego the case came under my care. The condition of intestinal stasis and the resulting autointoxication was so evident that a short-circuit operation was suggested and accepted. The result in this case has been the happy transformation of the patient from a condition of chronic invalidism to one of perfect health in a very short time. The gastric irritability has entirely disappeared. She is now able to eat heartily of any ordinary food, and all the exceptions in her dietery, previously necessary, have been eliminated. These histories I could reproduce until you would weary of them, but they are sufficient to illustrate stasis cases, and the great efficiency of Lane's short-circuit operation as a method of cure.

The water absorbing function of the colon is better known to surgeons since the use of Murphy's drop method of proctoclysis. The dryness of the colonic contents may be avoided by causing the patient to drink large quantities of water. This constitutes a most important hygienic step in the course of constipation. Liquid paraffine, or, as it is known in our pharmacopeia, liquid petrolatum, passes through the intestinal canal comparatively unchanged, and is the most efficient lubricant for the colon that can be given by the mouth. In practice it is found that a dose of from one to three ounces, given preferably in a glass of cold water at night, is sufficient to overcome many obstinate cases of constipation during the time that it is used. As the mechanical causes of the constipation are not influenced by the use of this remedy, it may be necessary to continue it indefinitely, and it is far better to give a daily dose of just sufficient size to produce a regular movement than to cause a spasmodic movement by the use of a large dose for the purpose of clearing accumulations. When these measures fail to relieve the autointoxication, even though the constipation itself is relieved, Lane's short-circuit operation should be done. This I consider one of the most important procedures that has been devised during recent years.

The technique of the operation has been described by Mr. Lane in a monograph. As this monograph may not be in all of your libraries, I will take the liberty of describing the technique which I follow, and which I have seen Mr. Lane use in his clinics both at Guy's, and the Children's hospital in London.

The necessity of this repetition of Lane's technique is emphasized by the misunderstanding that evidently exists. In the *Medical Record* of April 12th a surgeon of national reputation describes a faulty short-circuit operation, and invites the unwary to error by enlarging upon the ease with which it may be done. He says, "The ileum or *cæcum* is placed against some convenient segment of the sigmoid colon, and the two structures held temporarily by traction sutures are quickly united in such a way that four or five feet of the offending colon are thrown out of commission." Such a method while enticingly easy must surely be followed by a considerable percentage of cases of fæcal regurgitation and impaction. Recently in our town a surgeon removed a colon filled with impacted fæces. Some months previously a short-circuit operation had been done at a well known clinic. At a meeting of a medical society when the short-circuit operation was under discussion an internal medicine colleague protested against it. He had returned from a prolonged sojourn in Vienna, where he had seen the enormously distended colon removed in two cases after short-circuit operations. Later on, talking with him, I found that the cæcum had been anastomosed with the sigmoid, which the author above quoted would lead us to believe was a proper thing to do. To insure success, Lane's technique should be followed without any variation.

In preparation for the operation it is of the

greatest importance to thoroughly clear the colon from fæcal contents. This preparation should be begun at least two days before the time of the operation, and two or three large doses of castor oil should be given during this time. It is of the highest importance that the tissues be well loaded with water before the time of the operation, the reason for this being that in event of post-operative vomiting the patient will be deprived of water, as, owing to the displacement of the colon from the fæcal circulation and the low position of the sutures in the anastomosis, the post-operative administration of water by the colon is not advisable. So necessary is this that during the progress of the operation subpectoral injections of physiological saline solution are given. The needles are connected by a Y tube with a reservoir containing two quarts of deci-normal salt solution, and as the operation proceeds the entire quantity allowed to run under the breasts.

The operation is done with the patient in a horizontal position. The incision extends from the pubes to the umbilicus. The peritoneum is fastened to the towels by suitable clamps. The clamps are covered with moist towels, and the intestines are brought out of the pelvis and laid above the incision on these towels, and then covered either with warm moist towels, or, as Lane does, with a piece of thin white silk soaked in liquid paraffine. This is transparent, shows the intestines well, and of course completely protects them. After a general examination of the abdominal contents the cæcum and ileum are brought out of the wound. The rectum is then located by passing the hand into the pelvis and following it upward, making sufficient traction to bring the lowest accessible point just above the promontory of the sacrum. It is then clamped with an ordinary curved stomach clamp covered with rubber. A sufficient portion is brought through the clamp to make a ready anastomosis with the severed ileum. A moderately heavy silk or linen suture is passed bit by bit under the peritoneum like a purse string, crossing from the right to the left side to close the opening on the posterior peritoneal surface, which would exist when the ileum is anastomosed to the upper part of the rectum. The mesentery here contains many large vessels, the wounding of which with the needle might be serious. This suture must therefore be introduced with great care. It is not tied at once, but is clamped with artery forceps and laid aside. The ileum is clamped about 2 inches from the ileocæcal valve. A thin catgut ligature is tied into the groove left by the clamp. A straight, soft intestinal clamp is then fastened upon the ileum about an inch above this, and suitable ligatures placed in the mesentery. The ileum is then cut off flush with a forceps, and again just above the ligature, these ends being carefully held away from the sponges and tissues. The stump is immediately cauterized with a Paquelin cautery, which is also drawn across the cut edge of the upper part of the ileum which is held by the forceps. The lower part of the ileum is then inverted with a suitable silk or linen purse string to make it doubly secure. The ileum is now brought to the upper part of the rectum, and a half turn upward taken with the forceps that clamp the ileum, thus bringing the outer part just above the clamp against the side of the rectum. This is stitched on with continuous suture of fine silk or linen, as in the first line of suture in a gastro-enterostomy, when it is done by continuous suture. When this line of suture is completed a vertical incision parallel to it is made in the rectal wall, the parts being then surrounded by additional sponges, and the upper clamp is removed. If the ileum does not seem to be entirely empty, it will be well at this time to place a soft intestinal clamp, covered with rubber, several inches above the end to prevent the contents of the ileum from coming down over the wound. The second line of suture is now placed immediately above the first line, and then the other side of the anastomosis is completed just as the upper line of suture would be in gastro-enterostomy. After the completion of this line of suture the towels immediately surrounding the field of operation are removed, and the operator either changes his gloves or thoroughly cleanses the ones he is wearing. The retroperitoneal purse string is now tied. This may be done by the assistant, while the operator, passing his hand just above the anastomosis,

makes sure that no loop of the ileum is within the grasp of the suture, and also in observing its gradually tightening effect controls the tension placed on it by the assistant. After this is tied a second assistant passes a soft rectal tube about 16 inches in length into the rectum. The operator guides this through the new anastomosis into the lower part of the ileum. The assistant then fastens the tube with a silkworm suture, which is passed first through the skin of the perineum, and then through the wall of the tube. This tube is allowed to remain in position for about six days. It serves for permitting the ready escape of the contents of the ileum, whether fluid or gas, and is an important factor in preventing the possible post-operative abdominal distention. In practice I find that this maneuver is not as easy as it would seem, and I find it decidedly advantageous to cut rather deep notches into a side of the rectal tube, so that they can be readily felt by the operator, and be used to assist in drawing the tube upward. One of these notches is placed about half an inch from the end, and the other about 2½ inches further down the tube. They should be deep enough to be readily felt through the intestinal wall, and furnish some purchase for drawing it upward. When the tube is first introduced it is inclined to curl upon itself in the rectum, and illustrates to me very well the fallacy of the so-called high enemas. I am convinced that in giving them, the tube almost never enters the sigmoid, but curls upon itself in the rectum. By passing his hand into the pelvis the operator can feel through the rectal wall when the tube comes into the bowel, and guide it upward into the opening. The notches are of great assistance in this, and also when it passes into the ileum. The ileum should be drawn down upon the tube at least a foot, so that the end is well placed in the small bowel. This completes the operation, and the abdominal wound may be closed in the usual manner.

Fæcal regurgitation after this operation has occurred in a few cases; fortunately, however, not in my own practice. It was the fear of this occurrence that caused me to recommend appendicostomy as a routine safety measure in Lane's operation. This I did in a paper published in the *Annals of Surgery* in April, 1911. At that time Lane's operation was popularly considered to be an ileosigmoidostomy. If ileosigmoidostomy is done, fæcal regurgitation will frequently occur, for the reason that an important factor in the production of the stasis is the last fold in the sigmoid. The anastomosis must be done below the sigmoid at the upper part of the rectum. Fæcal regurgitation then must be exceedingly rare. I know that it does occur occasionally, for I saw Lane remove a colon which he had short-circuited nine months before, in which there was a fæcal mass in the cæcum. In about forty short-circuit operations which I have done, I have not had so far a single case of fæcal regurgitation. For this reason I have abandoned appendicostomy. I still have under observation several of the cases I operated on while I was doing this. Only one of them, however, makes any use of the appendicostomy opening. About once in six weeks or two months she flushes out her colon.

By following with care Lane's technique in fastening the peritoneum to the towels, and in cleansing or changing gloves after the anastomosis has been made, I have not had suppuration or any secondary infection in a single one of the cases on which I have operated. The post-operative convalescence is many times symptomless. The final results of the operation are so good that I am convinced that in time it will be generally accepted as a means of permanent cure of intestinal stasis. The measure seems so radical that many of the profession hesitate to accept it, or turn it aside with indifference, or even violently oppose it as an unreasonable and dangerous measure. To avoid making this a just censure, the operation should be undertaken only when hygienic and medicinal measures have failed to cure, and then only by surgeons well skilled in intestinal surgery, following implicitly the details which Lane regards essential. The operation is by no means as easy as a gastro-enterostomy. The indifference and even opposition with which this measure has been received is, I am satisfied, due to a lack of understanding of what it is and what it will accomplish. Time will surely give the operation its proper position.

# THE OPERATIVE TREATMENT OF ACUTE GONORRHŒAL EPIDIDYMITIS[1]

By JOHN H. CUNNINGHAM, Jr., M. D., Boston

SINCE Dr. F. R. Hagner first published the technique and results of his method of operation for acute gonorrhœal epididymitis in 1906, his method has been employed by many surgeons. The experience of others as well as that of Dr. Hagner has been reported from time to time in medical literature. A study of these reports shows that there exists a uniform opinion in regard to the results of this method of treatment, which is that this procedure when applied to cases of severe acute gonorrhœal epididymitis is followed by immediate relief of pain, a drop in temperature and of leucocytosis and that the convalescence is materially shorter than it is by the expectant form of treatment. In no report is there mention of any recurrence of the disease in the organ operated upon. In a large proportion of the cases the absence of a recurring active discharge after the operation has been significant and in some no recurrence of the urethral discharge has appeared. Whether or not this operative procedure lessens the percentage of sterility in the individuals who have the disease in bilateral form has not as yet been determined.

It is with the desire to add my experience in support of this form of treatment of this malady and to speak of the pathology and of the subject of sterility following this method of treatment in bilateral cases that this communication is presented.

Acute gonorrhœal epididymitis cannot be considered as being other than an acute inflammation of this appendage. The operative interference in this malady is the simple application of the principle of drainage to an acutely infected organ. It appears that Pirogoff recognized this fact and punctured an acutely inflamed epididymis as far back as 1852, and H. Smith in a publication in 1864 mentions a series of 1,000 cases in which he punctured the acutely inflamed epididymis with beneficial results. It appears that the value of drainage in this disease was lost sight of until Hagner published his technique in 1906.

As is well known, acute gonorrhœal epididymitis is very common. It is variously estimated to occur as a complication of gonorrhœa in twenty to thirty per cent of the cases. Gonorrhœal epididymitis results from an extension of a posterior urethritis along the ejaculatory ducts and vas deferens. Infection of the prostatic glandular tissue (prostatitis) usually is present before this extension takes place. Occasionally the prostate may escape the infection, the inflammation extending almost immediately to the epididymis from the deep urethra. Inflammation of the ampulla, the vas and the seminal vesicle generally takes place. The inflammatory process continues along the mucous membrane of the vas to the tail of the epididymis where the extension of the disease is usually arrested, probably because of the convoluted character and minuteness of the canal. In the severer forms of the malady, the body and head of the epididymis are also invaded. Epididymitis is usually unilateral. Double simultaneous epididymitis is extremely rare. Subsidence of the process within one organ and its subsequent appearance in the organ of the opposite side in the course of a few days is not unusual. Why the inflammation extends along one duct and not the other at the same time when these two ducts open at a distance from each other of but a few milimeters is not clear. The extension on one side only may be due to the occlusion of one opening by swollen mucous membrane, while the other, remaining patent, allows the infectious product to gain entrance.

Since 1906 the writer has employed this method of treatment in most of the cases of acute gonorrhœal epididymitis that have been in his care and has not restricted the

[1] Read before the American Association of Genito-Urinary Surgeons, May, 1913.

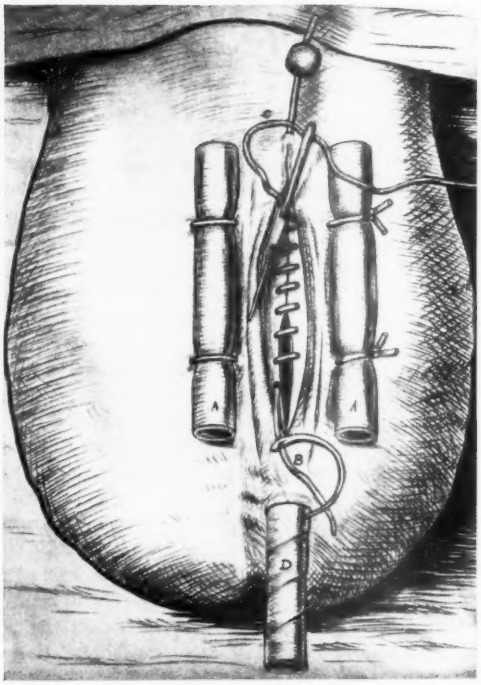


Fig. 1. *Manner of closing the scrotal wound.* A—A two rubber tubes over which are tied the silkworm-gut sutures passing through skin, dartos, and tunica vaginalis. B, catgut suture uniting the edges of the tunica vaginalis. C, subcutaneous silkworm-gut suture closing the skin wound. D, drainage tube placed along the outer side of the punctured epididymis.

treatment to the very severe forms of infection as Dr. Hagner has done. In collecting the material for this paper, fifty-seven cases from which reliable deductions may be drawn. were used. Of many other cases upon which the operation was done so little is known that they are not mentioned except to say that the immediate relief of the symptoms is known to have taken place. Hagner's technique, with the exception of closing the wound, has been followed in most of my cases.

From some of the patients pieces of the epididymis were resected for the purpose of pathological study, which is one part of this communication. There were six patients upon whom a bilateral operation was done. From these, observations have been made with regard to the occurrence or the contrary of sterility.

Hagner's technique is as follows: The junction of the epididymis with the testicle is defined and an incision about two inches long is made through the scrotal skin along this line. The tunica vaginalis is opened and such fluid as may be present in its cavity escapes. The swollen epididymis with the testicle is delivered. The epididymis is now punctured in many places with a narrow bladed knife in the inflamed area. The punctures must penetrate the infiltrated fibrous covering and the body of the epididymis must be entered by the point of the knife. If pus escapes from the punctures the opening through which it makes its exit is to be enlarged and the cavity from which it comes is washed out with a corrosive sublimate solution of 1:1000 strength by means of a syringe.

If the punctures do not yield pus after the puncture has been made through the fibrous covering they should be probed with a small probe or director. In this way at times foci can be opened which may have escaped puncture with the knife. The epididymis should be squeezed and its surface and that of the testicle and tunica vaginalis sponged with a corrosive sublimate solution of a strength of 1:1000 followed by a sterile saline solution. The testicle is then replaced. A puncture is made at the bottom of the scrotum through which a rubber dam drain is placed in such a way that it lies along the outer side of the whole length of the epididymis. The skin wound is then closed by passing two silkworm-gut stay sutures through the skin, dartos, and tunica vaginalis and tied over rubber tubes one on either side of the wound. The tunica vaginalis incision is closed by continuous fine catgut suture and the skin incision by a subcutaneous silkworm-gut suture (Fig. 1). A sterile dressing and a supporter are applied. The stay sutures are to be removed at the end of the first twenty-four hours, their purpose having been to prevent the dartos from retracting and thus causing ecchymosis in the lax scrotal tissue. The drainage dam is removed on the second day. Most cases are up on the third or fourth day. The silkworm-gut skin suture is usually

removed on the eighth day. In many of the cases the catgut knot works out, which delays perfect healing. If the two silkworm-gut stay sutures prevent all bleeding from the dartos, as they usually do, the catgut suture of the tunica vaginalii may be omitted.

The writer's experience in the performance of this operation has shown that in all but five cases there was fluid in varying amounts in the tunica vaginalis. In those in which this fluid was examined for the gonococcus none were found, nor were any other organisms present.

In the five cases in which there was no fluid there was an agglutination between the visceral and parietal layers of the tunica vaginalis brought about by an inflammatory exudate which bound the epididymis to the parietal layer. In all of these cases the disease was of more than three days' duration, and in all but one it was of five days or more.

In 67 per cent of the cases gross pus in varying amounts was demonstrated, and in each instance when it was not present, but the material obtained by the punctures was examined microscopically, pus was always found. The latter class included all the cases of short duration.

From this fact it is believed that if these cases were left without operation they would have gone on to resolution or to the pathological condition seen in those of longer duration.

The organisms found in the pus from the punctures of the epididymis have always been the gonococci. When the gross pus was examined this organism has usually been found. In the earlier cases before gross pus was present, the gonococcus was often but less frequently found.

The testicle has never been observed to be involved except by the extension of the epididymeal congestion over its surface.

In regard to the post-operative observations, the absence of pain on recovering from the anæsthetic has been the greatest recommendation for the operation; the fall of temperature and of the leucocytosis and the rapid disappearance of all evidence of toxæmia has been the same as in other cases reported.

The convalescence has been materially shortened as compared with that seen in connection with the expectant treatment.

The urethral discharge has recurred in all but four of the cases, but it is a noteworthy fact that the recurrent discharge was seldom as severe as when the disease is treated by palliative measures. In the vast majority of the cases the subsequent treatment of the prostate and the seminal vesicles was not so prolonged as it is in the average case of the disease in these structures without the concomitant development of acute epididymitis. This feature is not easy to understand. It is, I believe, important to treat the prostate and the vesicles whether the discharge is little or great, following the subsidence of the process in the epididymis, for these structures are usually involved in the cases in which the infection passes to the epididymis.

Brönnum has found the gonococcus in the secretion of the seminal vesicle on the same side as the inflamed epididymis in 80 per cent of the cases and in the other 20 per cent leucocytes without the organism.

As a rule, I have begun the treatment of these structures by massage and deep urethral injections about two weeks after operation.

Two patients who developed the disease in the organ of the opposite side did not return after the operation for treatment of the infection remaining in the genital tract, because the symptoms immediately following the operation were so slight.

In four cases I combined the Belfield procedure of opening the vas together with the epididymotomy. These cases did not show results differing from those in which this operation was not done.

In regard to the duration and occurrence of induration remaining in the epididymis after operation, I have seldom seen it disappear in less than two months, but the cases observed several months after the operation do not present the discreet indurated sclerotic areas in the globus major or minor which are discovered as a sequelæ of epididymitis in which the operation is not done.

In no instance of which I have had knowledge has there been a recurrence of the disease in the epididymis operated upon.

In my series I have operated bilaterally in six cases. Two of the patients had no further treatment after the first epididymotomy and

developed the disease on the opposite side. Two owe their infection on the opposite side to a newly acquired infection after the previous infection had disappeared, and two developed the disease while under treatment. The two patients acquiring the new infection developed the disease in the epididymis not at first affected and operated upon.

Fortunately, I have been able to make observations in regard to the presence of spermatozoa in all of these cases. One of this group was married five years ago and has two children. Another has been married over four years and has two children.

The seminal fluid from two others has been examined, it being collected in a condom during sexual intercourse. Both patients showed numerous living spermatozoa. Two others have had no intercourse and the fluids obtained by massage of the vesicles showed no spermatozoa. One of these patients was operated upon the second time four years ago, the last examination of the massage fluid being two months after the last operation, at which time he still had a slight discharge. I have been unable to locate this patient for examination at this time. The other patient showing no spermatozoa in the massage fluid is still under treatment for disease within the prostate and vesicles. It is of interest to note that the massage fluid from the two patients who showed living spermatozoa in the seminal fluid collected in the condom, showed no spermatozoa in the massage fluid, though spermatozoa were numerous in the fluid that was collected during the sexual act.

In regard to the pathology of the condition, it is well known that the process is most active in one part of the epididymis, most often in the tail or globus minor and next most frequently in the head or globus major.

It has been observed clinically that the inflammatory exudate resolves without clinical evidence of abscess formation. It has also been observed that a secondary hydrocele dependent upon the inflammation in the epididymis occurs in most of the cases. In the reparative process, connective tissue changes take place resulting in hard nodules at the site of the acute process. These changes are usually permanent and may occlude the seminiferous tubules or canals of the epididymis, so that the spermatozoa cannot escape or are impaired in vitality in so doing. When both epididymes are involved, sterility may result. Buzla in this connection states that an investigation of the soldiers of the German army showed that 41.7 per cent of those who had bilateral epididymitis were childless. Liegeois (Kocher) found in twenty-eight that after bilateral epididymitis spermatozoa were absent from the seminal fluid in twenty-one.

For the purpose of histological study, pieces of the inflamed areas have been removed in some of my cases. These specimens were studied by Dr. F. W. Mallory, director of the pathological department of the Boston City Hospital. The pathological histology varies with the duration of the disease. In the early phases—within three days—the ducts are distended and filled with polymophonuclear leucocytes.

Among them are also phagocytic endothelial leucocytes. In places the lining epithelium is destroyed and the exudation is directly continuous with an extensive infiltration of connective tissue with similar leucocytes. In places the tissue has been destroyed and dissolved so that small abscesses exist. At the periphery of the acute process there is some infiltration with lymphocytes and some proliferation of fibroblasts. In some of the polymorphonuclear leucocytes are flattened diplococci, shown to be Gram negative.

In a later stage of the disease there is shown a fewer number of polymorphonuclear leucocytes in the lumina of the ducts. The intertubular connective tissue is much increased in amount and is infiltrated in places with lymphocytes. In a few of the leucocytes, even in the instances in which the tissue has been taken as late as ten days after the onset, Gram negative diplococci have been found.

I believe that epididymotomy offers the best means of ending an acute gonorrhœal epididymitis and allaying the symptoms dependent upon this pathological condition. The small series of cases operated upon in which the disease was bilateral show a relatively high percentage not becoming sterile which is an important factor in support of this form of treatment.

# DEPARTMENT OF TECHNIQUE

## THE PROTECTIVE MASTOID OPERATION: AN OPERATION OF ELECTION[1]

By W. SOHIER BRYANT, A. M., M. D., New York City

THE point of view concerning the function of the mastoid operation has undergone a striking change. Formerly the entire idea of this operation was stern necessity — the last resort for the saving of life. In its present state of perfected technique, the mastoid operation usually accomplishes this function. Now technical skill and common sense have perceived in it a wider scope, a range of usefulness adapted to the supreme help of the ear.

The improvement in accuracy of diagnosis, certainty of prognosis and results of technique, justifies an extension of the field of usefulness of the mastoid operation. Formerly the mastoid operation has been usually an emergency operation; the protective operation is an operation performed at the time of election. The protective mastoid operation is a supplement to nature in her work of economy and conservation.

The protective mastoid operation should not be performed without profound technical deliberation. It is an axiom that we do not operate in every case of middle ear suppuration, for many cases of purulent middle ear inflammation convalesce satisfactorily without an operation. This is especially true in chronic middle ear suppuration, where many cases will heal with little difficulty and with very satisfactory results by appropriately applied milder treatment. As a general rule the cases that indicate a protective operation are those whose pathological condition is so far advanced that it seems unavailing to attempt milder treatment and also the cases which do not respond to mild treatment within a reasonable time.

The protective mastoid operation is definitely indicated in the following:

(1) All cases which have some residual hearing in the presence of middle ear suppuration resistant to mild treatment. The hearing will become progressively worse as long as the destructive process continues, because of the extension of ulceration and increased middle ear cicatrization.

(2) Cases of middle ear suppuration (with or without mastoid complications) which may be the source of chronic toxic absorption. The protective operation, by checking the suppuration of the ear, destroys this nidus of infection.

(3) Cases of middle ear suppuration (with or without mastoid complications) which may be the focus of infection causing serious complications, such as brain abscess, sinus thrombosis or meningitis.

An appreciable interval between the inception of the middle ear suppuration and the performance of the protective mastoid operation should be allowed in order to justify our conclusion that, in the case under consideration, the suppuration will not stop without a protective operation or in time to save the hearing, and also that the danger of serious complication is imminent. Proper diagnostic skill and due weighing of accurately ascertained diagnostic indications negate the chance of error in the election of this protective operation.

The ideal protection of the ear calls for the mastoid operation as follows:

1. The mastoid operation for the cure of chronic middle ear suppuration.

2. The mastoid operation for the cure of acute or subacute middle ear suppuration with or without mastoid involvement.

3. The mastoid operation to relieve the patient from a long and dangerous expectant period while waiting for resolution or for development into a mastoid abscess sufficiently urgent to require an emergency operation.

The special technique to be employed varies with the stage of the suppuration, its extent and the topography of the region involved.

*First group.* In cases of chronic middle ear suppuration, the various forms of radical mastoid operations are protective operations because:

They destroy the focus of infection of the discharging ear which supplies pyogenic organisms disseminated by means of linen, dust, hand

[1] Read before the American Otological Society, Washington, D. C., May 8, 1913.

shaking and various other ways. A source of infection is thus destroyed which might have become a source of general infection and which might have given rise to every grade of pyogenic infection, to the most virulent.

They destroy the source of bacterial poisons, which are often the source of chronic toxic absorption, as is seen in cases with chronic middle ear suppuration. The protective mastoid operation interrupts this morbid cycle giving the individual a chance to recover normal health after the suppuration of the ear has been corrected by the protective operation.

They arrest chronic middle ear suppuration and prevent terminal complications, such as brain abscess, sinus thrombosis, meningitis, broncho-pneumonia, bacteræmia, nephritis, pericarditis, endocarditis and erysipelas.

*Technique:* Various techniques have been devised for the mastoid operation for the radical cure of middle ear suppuration. They are all founded on a common principle, namely, the obliteration of the mastoid antrum. Different techniques have been advocated by Schwartze, Stacke, Heath, Bondy, Mahu, Streit, Luc, Barany, Citelli and others.

I prefer the techniques that destroy the least tissue and of them I prefer the technique that I have adopted in either the conservative radical operation or the modified radical operation.

The conservative radical mastoid operation is indicated when the middle ear structures are of no further auditory value or are destroyed. In my conservative radical mastoid operation the middle ear is not curetted and no tissue is removed from it. The antrum is opened widely into the auditory canal, the outer anterior wall of the attic is removed with its contents, the Eustachian tube is preferably kept open, and the restoration of a cicatricial drum membrane is not hindered in any way.

The results in this conservative radical mastoid operation are: an arrest of suppuration, a stable middle ear cicatricial condition, no painful dressings, a shortened convalescence, no disfigurement and taking into consideration the loss of the middle ear mechanism a maximum of hearing. In this operation, the hearing is improved beyond what it was before the operation.

The modified radical mastoid operation is adapted to the radical cure of chronic middle ear suppuration when the middle ear sound transmitting mechanism is still capable of some functional activity.

The operative field is attacked as in the conservative radical but the attic is not obliterated; it is opened only as far as the preservation of the ossicles in position will allow.

The results in my modified operation are, in many respects, similar to those obtained in the conservative radical mastoid operation. In this modified operation, however, it is possible to obtain a shorter convalescence; and, since the election of this operation presupposes some residual functional activity of the middle ear mechanism, it is possible to obtain a higher degree of hearing, often above normal. In this operation, also, the hearing is improved beyond what it was before the operation.

*Second group.* The mastoid operation is indicated as a protection in many cases of acute or subacute middle ear suppuration with or without mastoid complications, when the indications point to eventuation into a chronic middle ear suppuration which, for its final cure, will require a radical mastoid operation.

Under these circumstances the indications for the operation are based on the Röntgen-Ray findings. All acute cases of middle ear suppuration should be skiagramed. Where the skiagram shows a mastoid bone without air cells surrounding the antrum, we are reasonably certain that in these cases the suppuration of the middle ear will not readily yield to treatment. Furthermore, we are practically sure that the acute suppuration will eventuate into chronic suppuration, if, indeed, it is not brought to an abrupt termination by the development of the fatal complication of mastoiditis. After the inception of middle ear suppuration in dense mastoids, an interval of from 4 to 8 days should intervene before doing my modified radical mastoid operation. Cheatle's anatomical observations form the basis of the indications.

The technique of the operation for the cure of acute suppuration of the middle ear with the solid mastoid bone is the same as the technique of my modified radical operation.

The results of my modified radical operation in acute cases of middle ear suppuration in solid mastoid bones are: arrest of suppuration, stable middle ear condition, no painful dressings and a moderately short convalescence. Also the results are better for the hearing and, in proportion to the previous group, more cases are restored to normal or above. In many cases the hearing is improved even beyond what it was before the suppuration of the middle ear.

*Third group.* In acute or subacute infections of the middle ear, the protective mastoid operation is indicated to relieve the patient from a dangerous expectant period while waiting for a

mastoid abscess to develop or the suppuration to resolve. This group is limited to the cases in which the skiagram reveals pneumatic cells communicating with the antrum. The most important indication for the operation is unsatisfactory drainage, even after myringotomy and douching.

A protective mastoid operation is advisable in order to cut short the process because of the danger to the patient from capital complication of middle ear infection which may arise at any time without warning. The protective mastoid operation is also indicated on account of the impairment to hearing caused by the middle ear suppuration. The longer the continuation of the ulcerative process, inevitably associated with this suppuration, the greater the loss of the essential parts of the sound transmitting mechanism of the middle ear. The longer a suppuration lasts and the greater the destruction of tissue, the more abundant will be the final cicatrices, which hamper the physiological sound transmission of the middle ear.

After the inception of middle ear suppuration in cellular mastoids, an interval of from 7 to 14 days should intervene before doing my simple mastoid operation.

The technique of my simple mastoid operation demands the removal of the mastoid process, the opening of all cells, the removal of all affected bone, the removal of the available posterior osseous meatal wall between the annulus tympanicus and the facial ridge, the leveling of the edges of the bone wound and the longitudinal section of the membranous canal along the posterior inferior wall, the closure of the posterior wound with the insertion of a minimum drain followed by its early removal, that is to say, my modified blood clot dressing.

The results in my simple mastoid operation are the same as those in the previous group except that the minimum time of convalescence is reduced to as low as three days and that the hearing is more frequently restored to normal or above and in still more cases is improved beyond what it was before the suppuration of the middle ear.

The object of these three elective operations — conservative radical, modified radical or simple mastoid — is:

From a pathological standpoint — to stop the suppuration.

From a protective standpoint — to forestall complications.

From a functional standpoint — to preserve or improve the hearing.

The supreme test of the technique in a specialty of any definite organ is the conservation of the function of that organ. Our specialty is too often criticized as accomplishing too little in the preservation of the hearing. The mastoid operation offers, when used according to the indications, the most effective method for the seasonable amelioration of the consequences of persistent suppuration. Thus, in addition to the important function of stopping the suppuration, the elected operation, by providing the maximum protection to the parts of the hearing mechanism, preserves the hearing which is in jeopardy.

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# POSTURAL TREATMENT OF POST-OPERATIVE ABDOMINAL ADHESIONS[1]

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ONE of the most troublesome conditions the surgeon is called upon to treat is recurrent and persistent post-operative abdominal adhesions. The unfortunate victim of these adhesions may be completely disabled by the constant pain and the surgeon may find that even after repeated operations no permanent relief can be obtained. Of course, the majority of these cases may be expected to recover satisfactorily after the usual operative measures for the relief of these adhesions, but there is a small percentage of cases which seem to resist all treatment and to get worse after each of several operations; it is these more serious cases I wish to consider briefly and to suggest a procedure I have used successfully which may serve to relieve some of these patients; it will be noted that I say *relieve* the symptoms and not necessarily to *cure* or *prevent* these adhesions, for I think it is useless to hope for an anatomical cure in some of the worst of these cases.

The whole subject is full of puzzling contradic-

[1] Read before the Clinico-Pathological Society, Washington, D. C., February 18, 1913.

tions; in the first place we cannot explain why these adhesions sometimes result after the most trifling surgical interference, while in other cases they do not follow even prolonged exposure or forcible manipulation of the abdominal contents; and again, the relation between the adhesions and the resulting symptoms are contradictory; extensive adhesions often are not accompanied by discomfort, and *vice versa*, severe symptoms are often produced by very slight adhesions, though no doubt the recent findings of the marked differences in sensibility of various parts of the peritoneum will explain this apparent variability of cause and effect.

It is, of course, of first importance to prevent these post-operative adhesions so far as can be done by a careful technique, for they may not only cause great discomfort to the patient and thus mar the otherwise good results of a successful surgical procedure, but these adhesions are the chief cause of acute intestinal obstruction. Much may be done by consuming as little time as possible in operating, for mere exposure of the open abdomen to the air is known to be harmful; by inflicting as little trauma as possible; by avoiding unnecessary manipulation, violent sponging and wound retraction; by careful hæmostasis, as blood-clots in process of absorption will cause dense adhesions; by using only moist sponges and pads as dry gauze is particularly irritating; by the use of drainage only when absolutely necessary and then by using rubber drainage tubes or gauze protected by rubber tissue and never unprotected gauze packing; by covering raw surfaces and pedicle stumps as completely as possible with peritoneum or omentum; by protecting the intestines from irritating fluids or antiseptics and especially to prevent coils of intestine from lying on the unprotected field of operation which has been prepared with iodine, and this is probably of present importance because of the almost universal use of this irritant antiseptic for skin disinfection.

These points of surgical procedure are axiomatic and their value need not be elaborated here; however, the most careful surgeon cannot always avoid the exposure of long operations; much manipulation is often necessary; drainage must often be used; the peritoneum even in so-called "clean cases" must always react somewhat to take care of at least a slight infection, for of course absolute asepsis is never attained in any surgical work. Even aside from the influence of these known factors, it seems likely that certain individuals have a marked tendency to peritoneal hyperplasia, just as other individuals may have an unexplained tendency to keloid growths on the skin.

There have been many methods proposed for the prevention and cure of these adhesions, some of which will be mentioned briefly. All methods recognize the uselessness of merely breaking up these adhesions and endeavor by some means to keep apart the raw surfaces until such surfaces can be covered with newly-developed peritoneum. Various substances have been used to accomplish this purpose, such as sterilized air, nitrogen or oxygen gases; the introduction of large quantities of salt solution just prior to wound closure was a routine procedure a few years ago, but the solution is too quickly absorbed to be effective. Sterile olive oil has been used, but the results have not been very satisfactory, some patients reacting rather severely to its presence in the abdomen. Cargile membrane, the dried sterile peritoneum of the ox, has been extensively used to cover the abraded areas of peritoneum, but positive evidence of its value is lacking, and after all this membrane can only be regarded as a foreign body whose successful application to large surfaces is difficult, for a little blood or serum will easily float it away from its proper position. Paraffin, lanolin, gelatine, gum arabic and similar substances have been used; the mere length of the list, like the remedies for whooping-cough, suggests that the value of any is doubtful.

Many reports from the literature could be quoted to show that these adhesions are serious surgical complications and that their treatment is often disappointing; Murphy reports a case in which 14 laparotomies were done for adhesions following appendectomy, with final good result; Grieffenhagen reports a case having 10 operations before even moderate relief was obtained. Three years ago Dr. Stavely read an article on this subject before the Washington Medical Society, in which after reviewing the causes and treatment of these post-operative adhesions he reported a case operated on seven times, including one intestinal resection, with only partial relief. Numerous similar reports indicate the frequency of the complication and the difficulty in effecting a cure.

I wish to report somewhat in detail a case which illustrates the great amount of suffering and disability which a victim of recurrent and persistent adhesions may be forced to endure. The clinical history is similar to numerous cases which have been reported and is only of possible interest because of the fact that complete relief was finally obtained by a means of treatment which so far as I know is somewhat original.

E. P., age 26, a single German servant girl of phlegmatic temperament, had the usual children's diseases and also typhoid when about 12 years old; menstruation began at 13 and for several years was somewhat scanty and painful, but she was fairly healthy until in 1906; at the age of 20 she was operated on in a Cleveland hospital for appendicitis. This operation was the beginning of a series of surgical experiences which lasted almost continuously for three years. She could give no information as to this first illness, except that the attack was acute and that the appendix was removed, the wound apparently healing without drainage. Within a few months she began to have severe, dragging pains in the lower abdomen and she was soon obliged to give up work, as the discomfort was especially great when she was on her feet. She was admitted to the gynecological service at the Garfield Hospital in January, 1907, complaining of this abdominal pain, which was especially severe at the menstrual period. A diagnosis of endometritis was made and the uterus was dilated and curetted. She left the hospital in about two weeks, but was readmitted in May, 1907, about 5 months later, complaining of constant pain in the right side and a beating or jumping sensation in the lower abdomen; said she could walk but little because of the pain, was easily tired and unable to work. Urination was painful, though urinalysis was normal. She was examined under ether but nothing definite ascertained. She left the hospital May 20, unimproved, with a diagnosis of neurasthenia; she was readmitted 10 days later, after having tried to work one day. For two or three weeks she suffered the usual pain and tenderness and had some irregular fever and occasional chills and slight leucocytosis; all laboratory tests were negative and Dr. Claytor referred her to my service for the relief of probable peritoneal adhesions resulting from the operation for appendicitis two years before. At operation extensive adhesions were found about the cæcum and also about the sigmoid; nothing else abnormal was found, and the pelvic contents were normal. The adhesions were broken up or dissected out and raw surfaces covered with cargile membrane or turned in with catgut stitches. She was discharged August 12 feeling very well. This improvement lasted only a couple of months and in December, 1907, she went to the Columbia Hospital where she was again dilated and curetted, and discharged in two weeks.

In April, 1908, she was again admitted to the Garfield Hospital where she was treated for the nervous and hysterical condition which had by this time become marked. After five weeks' treatment and rest she left the hospital considerably improved. However, a month later she presented herself again begging for an operation, which I reluctantly performed June 5, 1908. The condition found was worse than found at the previous operation; as the interne expressed it in his description "adhesions were found all over the peritoneal cavity." Over two hours were spent in breaking up adhesions and arresting hæmorrhage. Ten or twelve sheets of cargile membrane were used to cover the raw surfaces and were stitched into place; the abdomen was filled with salt solution and the wound closed. She made rather a tedious convalescence and left the hospital in two months feeling fairly comfortable. She tried to resume her work but the old familiar symptoms recurred in a short time and during the next eight months she haunted my office begging for relief and asking for another operation. During this time various abdominal bandages and supports were used with only slight benefit. She was comfortable in bed, but the erect position at once caused the dragging pain. I finally consented to operate a third time and opened her abdomen again on June 23, 1909. The adhesions were worse than at either of the previous operations; with great difficulty most of the adhesions were broken up, a special effort being made to free the parietal peritoneum. Large raw surfaces could not be avoided and it was evident that adhesions would necessarily reform; it was determined, therefore, to make an effort to have them reform with the intestines as low down in the abdomen as possible, so that in the upright position there would be less tendency for the downward pull which seems to cause most of the acute pain in these cases. With this purpose the wound was carefully closed with tier sutures, reinforced with wide through and through stay sutures, and a firm abdominal binder applied. Before final closure of the wound, the abdomen was filled with salt solution. As soon as she reacted from the anæsthetic she was placed in a sitting position and kept there. On the third day she was allowed to get out of bed and stand on her feet as much as her strength permitted. Within a few days she was walking around the ward, but still rested and slept in a partially upright position. She left the hospital in four weeks; she suffered no pain and improved rapidly, gaining 30 pounds in the next six months. She resumed her work and has continued well to the present time, a period of nearly four years.

From 1906 to 1909 this girl was in hospitals on ten occasions aggregating about 250 days, and underwent six operations. In spite of the fact she has remained comfortable for nearly four years, I am convinced she has as many adhesions as she ever had, but the present ones were formed when the abdominal contents were in their lowest position, so that there is now no pull on the parietal peritoneum when the patient is erect. From my experience with this case and from reports of many similar cases repeatedly operated upon, I think we must admit the impossibility of permanently removing these adhesions; but I believe many of these desperate cases can be greatly benefited by this postural treatment after the adhesions are broken up at operation. For this plan to be effective it is necessary, *first*, that all or nearly all adhesions be broken up, especially on the sensitive parietal peritoneum so that the abdominal contents may adjust themselves at as low a level as possible immediately after the operation; *second*, that the raw surfaces must be kept apart for 12 or 18 hours by salt solution, until the patient can be placed in the upright position, which must be done as soon as possible as it is known that raw peritoneal surfaces adhere very quickly.

The risk of such a procedure as this is not great and I believe it offers a good chance of relief to those recurrent cases not benefited by the ordinary operative measures.

# THE FALCIFORM LIGAMENT OF THE LIVER AS PLASTIC MATERIAL AVAILABLE FOR USE IN THE UPPER ABDOMEN

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WHEN dealing with an ulcerative or perforative lesion of the stomach or duodenum, one is not infrequently forced to devise some method to cover over a raw area with peritoneum, to reinforce a doubtful suture line or to seal a recent perforation which cannot be closed by a simple suture of its edges. Under such circumstances the omentum usually lends itself readily to the purpose providing an abundance of easily mobilized tissue of fairly good vitality; to secure the omentum in its new position one may depend upon the pressure of one or two supporting drains aided perhaps by a few sutures but when dealing with a perforation one must attempt a more or less accurate suture whose introduction may easily be difficult because of a poor exposure and whose efficiency may well be doubtful. So radical an alteration in the position of the omentum, however, is not altogether a matter of indifference for the lower abdomen is henceforth absolutely deprived of its best natural defense against acute inflammatory processes; many perforated appendices are safely walled off in whole or in part by the omentum. In addition, such a use of the omentum when made in a faulty technical manner may occasionally be the cause of a late intestinal obstruction. As a rule the best abdominal surgery is that which accomplishes its purpose with the least alteration of natural conditions.

The foregoing considerations lead the writer to try the falciform ligament of the liver as plastic material.

In the first case (Surgical No. 929) during an abdominal exploration undertaken to discover the cause of persistent epigastric pain there was found an ulcer of the stomach situated on the anterior surface, adjacent to the lesser curvature and well up toward the cardia. This portion of the stomach was firmly adherent to the under surface of the liver. After separation from the liver there was found a deposit of fresh greenish fibrin on the affected portion of the stomach wall indicating a more or less active process but without actual perforation. The patient's general condition being too poor to allow us to consider excision of the ulcer, it was necessary in some way to cover rapidly and securely the site of impending perforation. Attempt was made to bury the ulcer in the usual manner by folding over it the adjoining portions of the wall of the stomach and suturing them in this position but the area of induration was so large in comparison to the total size of the relatively small stomach that this method of covering proved quite insecure. It was evidently necessary to reinforce this suture line firmly and the falciform ligament of the liver naturally suggested itself as providing available material. The round ligament of the liver was therefore divided between ligatures close up to the peritoneal side of the umbilicus and the folds of the falciform ligament were divided just at their junction with the parietal peritoneum; this provided a flap almost entirely covered with peritoneum and hanging from the umbilical fissure of the liver. The free portion of this broad-based flap was now thrown over the insecure line of suture on the stomach wall where it was easily and snugly stitched into position; there was no tension whatever upon the flap and it seemed to fulfill the purpose admirably. The abdomen was closed without drainage and the patient made an uninterrupted convalescence. From the time of operation the patient was quite free from the pain previously complained of and when seen eight months later she had gained markedly in weight and expressed herself as having been perfectly comfortable.

Quite recently we have employed this method in the closure of a perforated duodenal ulcer. A young man (Surgical No. 1810) was admitted with the evident signs of an overwhelming fulminant general peritonitis. A diagnosis of perforated duodenal ulcer was confirmed by immediate operation; the peritoneal cavity was literally full of pus from which streptococcus pyogenes subsequently grew in pure culture. The perforation, which admitted the finger tip, was situated on the anterior wall of the first portion of the duodenum in the center of an indurated area perhaps 5 cm. in diameter; the edges of the perforation were so friable that approximating sutures promptly tore out. Invagination of the ulcer by Lembert sutures placed at some distance from the edge was likewise impossible for the reason just stated and also because of dense adhesions about the duodenum which effectively prevented its collapse. An attempt to close the perforation by suturing the adjacent portion of the transverse meso-colon over it was unsuccessful. The falciform ligament of the liver was then prepared in the manner described above and thrown down over the perforation when it was found quite possible to hold it in position with a few sutures in such a way as to occlude the opening in the bowel rather securely. In this instance the ligament was used as an obturator rather than as an overlying flap. Drains were placed in such a way as to hold the transplanted ligament in place and the omentum loosely drawn up about them. Free egress was provided for the pus in the pelvis and flanks by multiple incisions.

The patient succumbed to peritonitis 24 hours after operation. No autopsy was permitted but there was no evidence of any further post-operative leakage from the duodenum; the closure of the perforation seemed effectual.

Judging from the above experiences, the falciform ligament of the liver seems to be of some value as plastic material available for use in connection with defects of the stomach and duodenum. It is possible that it may serve a similar purpose in connection with surgery of the gallbladder, biliary passages, liver or transverse colon,

though no occasion for its use in this connection has presented itself to the writer as yet. The ligament offers a surprisingly large amount of tissue which is easily and quickly prepared, and whose vitality, when prepared by the method outlined above is assured, since its blood supply is by a branch of the hepatic artery.[1]

In suggesting this use of the falciform ligament, it is fully realized that the field is a rather restricted one, but since, within limits, its use has proved of considerable value to the writer he feels it worthy of remark. No suggestion of the possibilities of the falciform ligament as plastic material has been encountered in the literature, though, be it said, an exhaustive resumé has not been made. This brief presentation is made in order to call attention to the procedure and to recommend its trial when an appropriate occasion presents itself.

[1] Porier et Charpy, Traité de Anatomie Humaine, second edition, iv, 707, 1901.

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# THE SELECTION OF THE ANÆSTHETIC UPON THE BASIS OF ITS ULTIMATE PHYSIOLOGY

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THE all-important factor in combating disease and repairing injury is the patient's vital resistance. By Nature, physiologic agencies, so far as we understand them, are directed toward cure and repair. It is a matter, then, of supreme importance that any artificial means added be of assistance, and not a handicap, to Nature's supreme and all-pervading effort. "Preservation of life" has been asserted to be "the first law of Nature," meaning thereby that it is a matter of instinct to guard the individual against physical injury. This doctrine, however, is true in a much broader significance, and the potentiality resides in every cell and organ, for all the individual's normal, physiologic agencies are, or may be, directed toward the preservation of life. The great task of the profession to-day, then, is to conserve, restore, sometimes augment, but never unnecessarily impair, these physiologic activities. On the medical side it is generally conceded that the majority of patients recover without any assistance whatever. Our medical leaders, therefore, true to their conviction, gave little drug medication, and were accused of leading the way to drug nihilism. On the other hand, serums, vaccines, antitoxins, etc., physiologic products, are ever widening their field of use in both medicine and surgery, and seem to point the way to therapeutic progress and achievement. In other words, the era of physiologic medicine and surgery has already dawned.

In most surgical procedures it is necessary that a general anæsthetic be employed, and it is to the selection of this agent, in the light of this era, that your attention is here directed. Let us make the slogan of the day, "Conserve the Patient's Resistance." Accordingly, the effects, other than the anæsthesia, of the different anæsthetics become an important matter. No longer can the anæsthetic be considered a success if only the surgeon be unperturbed throughout the operation and the patient survive the table a reasonable length of time. "It is quite as important for the patient to retain his natural resistance after operation as it is for the surgeon to add artficial means for securing asepsis during operation. This is the new principle — turning the tide of battle only, and leaving the patient with his physiology as nearly intact as possible. It seems to me that the object lesson of the results of conserving the patient's natural resistance has opened the vista of a new epoch in surgery." (1).

Most every surgeon uses one anæsthetic as a basis, and has it administered unless he believes it is contra-indicated. He may not use his favorite anæsthetic for even a majority of his operations, but nevertheless he uses it unless there is what he believes to be a good reason for using some other anæsthetic. Nitrous oxide is conceded to be the least toxic general anæsthetic in use, and that it best conserves the patient's physiology. My plea is that it be made the basic anæsthetic, that is, that it be used unless, all things considered, it is deemed to be contra-indicated. Just what the contra-indications to nitrous oxide may be depends largely upon the attitude of the surgeon and the aptitude of the anæsthetist. I have administered it in point of time from a few seconds to over five hours; to patients ranging from a few months to 90 years of age; to athletic and alcoholic subjects; to patients with arteriosclerosis and high blood pressure, and

with cardiac disease; for practically every operation on the calendar, and under all kinds of circumstances. In a large proportion of these cases all anæsthetics might be said to have been contra-indicated; that is, they were poor anæsthetic and surgical risks, and for this reason nitrous oxide was selected. My greatest problem and fear has been with arteriosclerosis and high blood pressure. The authorities say that in these conditions nitrous oxide is contra-indicated, and they are undoubtedly correct; but can not the same be said of other anæsthetics? With what other anæsthetic would a patient 85 years old, and having marked arteriosclerosis with cardiac involvement and high blood pressure, pass through a three-hour operation (arteriovenous anastomosis, surgeon, Charles Goodman, Montefiore Home) without evidence of shock or other untoward symptom? Just recently I administered nitrous oxide to a woman, 71 years old, having marked arteriosclerosis and high blood pressure for pyometra and included a vaginal hysterectomy, perineorraphy and Goffe's operation for a large cystocele (surgeon, G. G. Ward, Jr., Post-Graduate Hospital), for an hour and fifty minutes with practically no shock, as evidenced by the patient's general condition, blood pressure observations, and prompt recovery without any anæsthetic disturbance whatever.

Again, a patient over 80 years old passes through an operation that lasts an hour and includes a laparatomy (surgeon, Charles H. Peck, Roosevelt Hospital) with the best of results, both anæsthetically and surgically considered. These cases are cited as illustrations only; many more might be given. To hold that nitrous oxide should not be administered to the aged, as some do, is to deprive a large class of the benefit of the very anæsthetic that I have found to be especially well adapted to their needs. It is true that these conditions require more care in administration, but that is technique, not selection.

The critics say that nitrous oxide should not be administered in heart disease, but this view is not supported by the best authorities. Hewitt again says: "It is now universally admitted that nitrous oxide is the safest general anæsthetic known." (2). This is indeed a remarkable statement, coming, as it does, from a foremost authority. In most of the deaths reported under nitrous oxide the asphyxial element was not entirely eliminated — an absolute essential that admits of no modification whatever — or other factors were present, such as respiratory restriction, acapnia, etc., which produce sudden fatalities under any anæsthetic.

My own experience has been that nitrous oxide causes less cardiac disturbance than ether, and that when nitrous oxide produces no cardiac disturbance ether may produce a marked cardiac depression, as the following will show: A patient, in a previous short operation, had marked cardiac depression under ether administered by one of our best anæsthetists. A few weeks later, in a two-hour abdominal operation (surgeon, S. G. Gant, Jamaica Hospital), nitrous oxide was used. The patient was quickly and easily brought under its influence, and the heart action was good. As there was some rigidity of the abdominal muscles a little ether was added to secure relaxation; the effect was immediate cardiac depression. A few minutes later a small amount of ether in conjunction with the gas-oxygen was tried again, with the same result as before. At the end of the operation the patient was in good condition, and made a very satisfactory recovery. Nitrous oxide, with this patient, was well tolerated. Another patient (surgeon, J. Van Doren Young, St. Elizabeth's Hospital) could not tolerate any ether whatever in conjunction with nitrous oxide, but did well on gas-oxygen only. This patient had suffered marked cardiac depression and toxic effect from a previous ether anæsthesia. These illustrative cases might be multiplied multifold.

Furthermore, I have not observed a single patient who tolerated ether, as far as heart action was concerned, better than nitrous oxide, providing there was no respiratory restriction. Acute cardiac dilatation, that has been mentioned in connection with nitrous oxide, is due, I believe, either to an element of asphyxia, or to impairment of the respiratory movement, conditions that produce acute cardiac dilatation either under or indeed without any anæsthetic whatever. Certainly, a patient 85 years old, having marked arteriosclerosis, degeneration of the myocardium and high blood pressure could not, without ill effect, withstand for three hours a general anæsthetic that had the slightest tendency, *per se*, to produce acute cardiac dilatation. Cyanosis and respiratory restriction may be prevented. This is a very important phase of nitrous oxide administration, differing considerably in degree from that of ether.

Alcoholics constitute another class in which we are told that nitrous oxide is contra-indicated, but here again ether and chloroform are also contra-indicated. Alcoholism markedly lowers vital resistance, especially against infection; ether and chloroform have similar action. Besides, in this class, both the liver and the kidneys are more or less involved, and thus distinctly contra-indicate

the more irritating and toxic anæsthetics, especially in the very prolonged operations.

Eclampsia and parturition were formerly considered cardinal indications for the use of chloroform. Laboratory investigation, however, shows that in eclampsia there is practically the same degeneration of the liver as that which often follows chloroform anæsthesia, thus positively contra-indicating the use of chloroform in this condition. And in parturition in general who can say that eclampsia may not supervene, or that the liver, already overtaxed, may not succumb to the burden superadded by this agent whose toxicity is especially directed toward this organ? We have been recently advised to use ether, but is this rational or scientific? The kidneys are also overtaxed; mayhap, already in the initial stages of inflammation. Administering ether is literally pouring oil upon smouldering coals. Besides, puerperal infection occurs occasionally. Why is nitrous oxide practically ignored in this connection? Is the profession so indissolubly wedded to its past in the use of ether and chloroform that it is willing to risk sacrificing even the mother rather than heed this new lesson of science? Plainly the warning has been sounded: "Conserve the Patient's Resistance!"

Infection of all kinds indicates the use of nitrous oxide, as both ether and chloroform, partially, at least, through their action on the phagocytes, impair Nature's agencies for repelling bacterial invasion. This is a much broader indication than is at first apparent, for it not only includes active and latent infection prior to the operation, but also infection that may occur during, or for several days subsequent to, the operation, as this impairment of the patient's resistance lasts five or six days. The operations in which infection is prone to develop even though the technique is as perfect as usual, such as in the operative treatment of fractures, use of metallic bone plates, etc., clearly indicate the use of nitrous oxide.[1] Finally, what surgeon of experience has not, on operating, found infection that was not previously diagnosticated?

In addition to impairing resistance against infection, ether and chloroform detrimentally affect the red blood cells, and the volume of the blood as well, thus handicapping Nature's agencies for repairing injured tissues.

The beneficent action of nitrous oxide upon the general nervous system, as compared with that of ether and chloroform, is very marked indeed. The long-persisting train of symptoms of nervous exhaustion, neurasthenia, etc., is strikingly absent after capital operations under nitrous oxide. Crile shows that there is only one-fourth the injury to the brain cells under nitrous oxide anæsthesia as that which occurs under ether, with the same amount of trauma. (3). I have found that insane patients do particularly well under nitrous oxide.

Patients of low vitality, or in shock, or where shock may be an important factor, should be anæsthetized with nitrous oxide. The reduction in amount of shock under nitrous oxide, as compared with that under ether, is very marked, both clinically and pathalogically. In fact, patients developing shock under ether are often improved by substituting nitrous oxide, as shown by McKesson. (4). Patients in fright; those particularly dreading the anæsthetic or operation, and those in great pain, or who have just passed through a period of suffering, do much better under nitrous oxide, as these conditions in themselves produce pronounced shock. In irritation or inflammation in the respiratory tract and lungs, diabetes, nephritis, pyelitis, cystitis, and in operation upon the kidney, ureter, bladder and prostate, the use of ether is contra-indicated on account of its irritant action. The comparative freedom from post-narcotic nausea, vomiting, depression and general discomfort alone under nitrous oxide renders it the anæsthetic of choice in a large number of cases. Many patients refuse, or fatally postpone, operative procedure on account of the unpleasant memory, or the disparaging recital, of a previous ether experience. Nitrous oxide, on the other hand, is known the world over as "laughing gas" solely on account of the pleasant impression it makes upon the patient's mind. And can you blame any patient for preferring to laugh rather than to vomit? After nitrous oxide administration consciousness is recovered very quickly, even after prolonged operations, and the patient, frequently with a smile upon his lips that emphasizes the truth of his statement, often tells immediately of the pleasant entertainment he has had while the surgeon was operating upon his very vitals!

It has been urged against nitrous oxide that its administration requires skill, that it is expensive, and that on account of apparatus and supplies required it is not adapted for use outside of institutions. Just a word as to each of these objections.

Does any one ever criticize an operation because, perchance, for proper performance it requires skill? It is a stigma upon the whole pro-

[1] At the meeting of the New York Surgical Society, April 23, 1913, several patients developing such infection were shown, and one case reported in which the infection developed early and was of such a severe type that the patient soon died.

fession to object to anything that is of benefit to the patient, especially at a critical time, because its use requires skill. The necessary skill for administering nitrous oxide, just as that required for any other work, will be forthcoming just as soon as there is a real demand for it. This demand cannot be originated by the anæsthetist; it must come from the surgeon.

The cost of nitrous oxide anæsthesia depends almost entirely upon the method of administration. With the method that I employ and have elsewhere described I use an average of thirty-three gallons of nitrous oxide and twelve gallons of oxygen per hour, thus costing hospitals about sixty-five cents per hour of administration (5). This cannot be said to be expensive.

The apparatus that I use weighs 6½ pounds, and can be compactly folded and carried anywhere, together with sufficient supplies for an anæsthesia of upwards of two and a half hours in an ordinary hand bag (6). Several other distinctly portable apparatuses have been described.

Lest I be misunderstood, however, let me say emphatically that I do not advocate the use of nitrous oxide for all patients, conditions and operations, for no anæsthetic fulfills that requirement. Besides, even though the selection of the anæsthetic seems to have been properly made, the unknown individuality of the patient may, upon administration, preclude its use, and a change be necessary. At the present time ether, with the majority of surgeons, is the anæsthetic of choice, and nitrous oxide is used chiefly as a means of last resort. My plea is that "the last shall be first," not so much in point of use, but from the standpoint of consideration. Hewitt recently reiterated his former statement that nitrous oxide, when administered with a sufficient amount of oxygen to prevent all asphyxial symptoms, is practically free from danger to life (2). Most certainly it leaves the patient's physiology in the most perfect condition. Recovery depends entirely upon resistance. Why, then, should not first consideration always be given the safe anæsthetic that best conserves the patient's resistance? This does not require that it be used in the majority of operations, but that it always be used, if this can be done advantageously. It makes a vast difference whether it always be used whenever reasonably advisable, or only as a last resort. The indications for its use ought to be balanced with its contra-indications. The contra-indications of nitrous oxide are relative, not absolute, and if its indications equal or outweigh its contra-indications, it ought to be used. Ether, on the other hand, has absolute contra-indications, such as in the more or less severe of the following: bronchitis, laryngitis, pneumonia, tuberculosis, infective appendicitis, peritonitis, nephritis, cystitis, sapræmia, septicæmia, bacteræmia, pyæmia, infective and some auto-toxæmias, debility, shock, etc. Relative contra-indications to ether become more absolute in very prolonged operations. That is, the longer the operation the more ether is contra-indicated, whereas with nitrous oxide the longer the operation the more it is indicated. Most of the contra-indications for nitrous oxide lie with the surgeon and the anæsthetist rather than with the patient and the operation. Experience and comparative clinical observation of its beneficent action, therefore, broaden its field.

Life is not preserved and health is not restored by impairing normal, physiologic agencies. When life is preserved, or health is restored, with the patient's resistance unnecessarily impaired, it is at a risk, and with a responsibility, that is not always justified. To handicap Nature needlessly with the anæstheic is sometimes to turn the tide of battle against the one we are striving to aid. Again I say, "Conserve the Patient's Resistance."

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# A MODIFICATION OF THE RECTUS FASCIAL FLAP IN INGUINAL HERNIOPLASTY

By GOODRICH B. RHODES, A. B., M. D., Cincinnati
Junior Surgeon to Cincinnati City Hospital, Good Samaritan Hospital, and Episcopal Hospital for Children

IN a certain proportion of cases of inguinal hernia, direct and indirect, the surgeon meets with a weakened, degenerated or lax conjoined tendon of the internal oblique and transversalis muscles, prohibiting its use as part of a reliable wall in hernioplasty. Especially is this true in long-standing, irreducible hernias.

To meet these conditions various plastic methods have been devised, employing muscular, fascial or periosteal flaps from surrounding structures. The method herein suggested appears to result in a restoration to a condition very closely approximating that obtained by the Bassini operation. The writer has hitherto employed it in only one case, an old, indirect hernia, with very gratifying result.

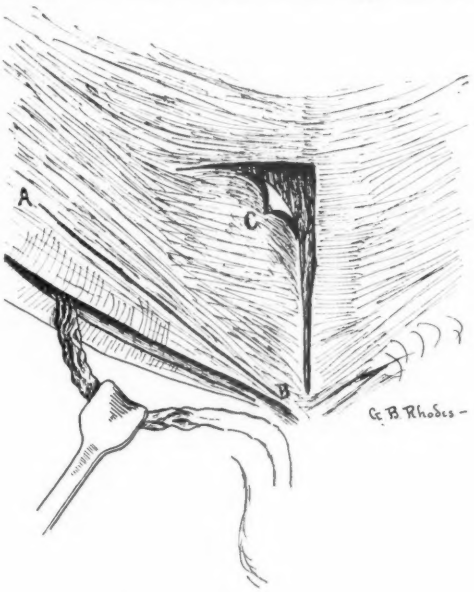



Fig. 1.

Approach to the operative field is made by a Ferguson incision with the convexity directed toward the midline of the abdomen, to allow easy access to the rectus sheath. The cord, sac and contents are treated as in the Bassini operation. After the sac has been tied off and returned to the abdomen the cord is crowded into the upper angle of the inguinal canal as far as possible, forcing it closely against the fibers of the internal oblique and transversalis at their origin from Poupart's ligament. With the spine of the pubis as a center, a distance is marked off on the rectus sheath equal to the distance from the spine to the cord at its entrance to the abdomen. This gives the level for the transverse section of the rectus sheath. The entire thickness of the rectus sheath is now converted into a triangular flap by

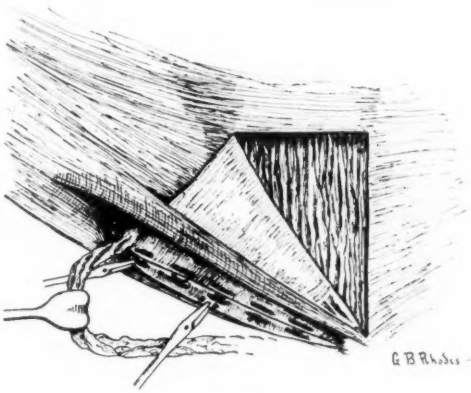



Fig. 2.

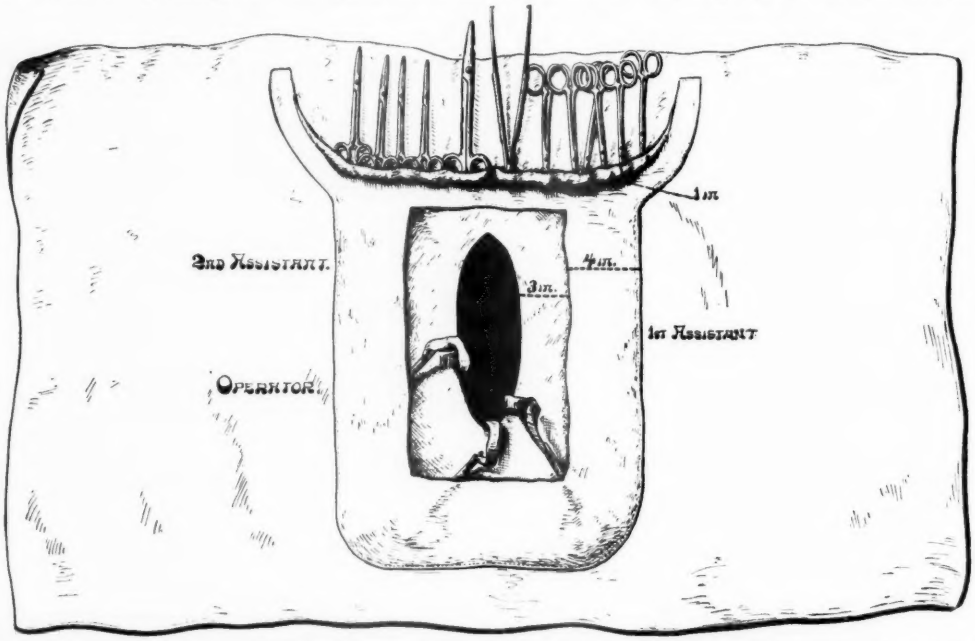
an upper transverse incision across the width of the muscle of the corresponding side, and a longitudinal incision near the midline of the abdomen, meeting the first incision above and prolonged down as far as the symphysis if necessary. The external oblique is now split in the direction of the fibers as shown in Fig. 1 A–B, and the flap C is pulled through the slit thus formed. The flap is sutured to the posterior shelving edge of Poupart's ligament, taking the place of the conjoined tendon, and the cord transplanted. Operation concluded as in a typical Bassini operation.

It may be objected that the space denuded by the removal of the rectus flap may become the site of a muscle hernia, but in practice it is possible to approximate the borders of the triangle with mattress sutures, so as to obliterate it, and the lower edge of the slit in the external oblique can be pulled over to assist in covering it.

# A LAPAROTOMY TOWEL

By HENRY J. VANDEN BERG, M. D., Grand Rapids, Michigan

THE accompanying illustration represents a laparotomy towel especially useful with the patient in the Trendelenburg position. It is designed to be placed over the ordinary laparotomy sheet. It is made with two pockets, a narrow, transverse one above and a deeper U-shaped one around the sides and lower end, as represented in the cut. The narrow pocket is intended to hold a few instruments such as are used constantly throughout the operation, viz:




catch forceps, scissors, and probably one or two other instruments, with the idea of having them close at hand, yet eliminating the nuisance and even danger of having them slide down into the field of operation.

We have found that the depth of this pocket should be from one to one and a half inches, or just deep enough to keep the instruments from sliding, yet not so wide that it becomes necessary to draw them out of a pocket, so to speak. This would interfere somewhat with the handiness.

On the operator's side the forceps are placed with the grip downward, making it handy for him to grasp, or for the assistant to quickly place them into his hands. On the assistant's side the position of the instruments is reversed for his convenience. We make it one of the duties of the second assistant to keep this pocket supplied from the tray and to keep it in order so that the operator and first assistant can always be sure of finding the instruments there and in place.

This arrangement brings the instruments just above the upper end of the incision and very close to the work. The larger pocket is used to hold the forceps which are attached to the tape of the laparotomy sponges. As the nurse hands over a sponge she drops the forceps into the pocket, which prevents them from sliding down possibly into questionable grounds and at the same time places them out of the way.

You will see that this towel has its greatest usefulness when operating, as above stated, in the Trendelenburg position, as it then serves a double purpose. However, the deep pocket for the tape forceps alone is of sufficient value to merit its use in all laparotomy work. We have used it now for seven years with satisfaction and recommend its use to other operators.

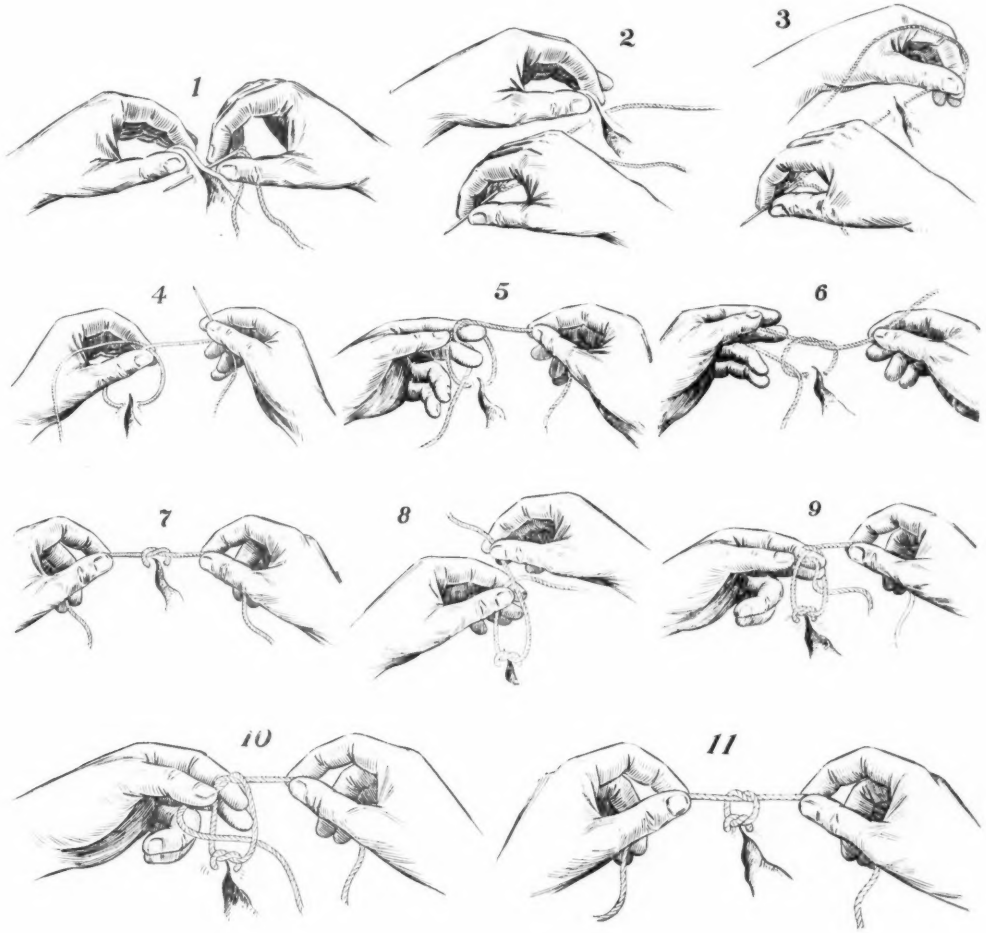
# APPLYING SKIN SUTURES

By WELLER VAN HOOK, A. B., M. D., Chicago

THERE are but few surgeons who have not given more or less attention to the rapid and efficient suturing of wounds of the skin, since almost all operations leave an integumentary wound that demands closure. Modern long incisions make rapid and substantial suturing a necessity.

The writer has tried many methods but for simplicity and generally effective applicability recommends the following:

Silk-worm gut is the best material. If soaked for a few minutes in methyl blue solution it will be much more easily seen. Fishermen, for whom the material was devised, like it best when quite translucent, since the lure is on this account less visible to the fish. The surgeon needs the opposite quality, that of opacity. The material should be thoroughly boiled with the instruments; this makes it soft and pliable and does not seriously affect its strength.



The needle should be a straight Hagedorn not too large. The skin edges are lifted and slightly rolled outward. The needle is then introduced into the skin at such an angle that when the stitch is tied (a) the edges are approximated without being turned out or rolled in; (b) the skin and the underlying fat-tissues are supported; (c) there are no gaps left between stitches.

The question of rapid and effective manipulation is largely solved by the use of the materials chosen. The straight needle gives the operator constant, accurate knowledge of the whereabouts of the point and the power, by the use of the needle as a carrier and lever, to adjust the tissues that are being manipulated.

The Hagedorn needle with its knife-edge point and large eye passes easily through the tissues making a clean wound and is very easily freed of its thread and easily armed again. With a little practice the surgeon can sew up a simple wound as fast as a quick nurse can supply threaded needles. The nurse should stand at the operator's left and, holding a bunch of well trimmed silk-worm strands in the right hand she can quickly thread them and either give them into the operator's hands or stick them in a towel near his right hand.

The Hagedorn needles should be sharpened on a small stone and polished with emery before each operation.

A rapid and certain set of manipulations in passing and tying the sutures is as necessary as are proper materials.

A series of such manipulations which the writer has long used are so illustrated in the accompanying drawings that the reader can easily understand and practice them.

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# CORRESPONDENCE

## IN RE THE MALIGNANCY OF GIANT-CELLED SARCOMA

*To the Editor:* In the July, 1913, number of SURGERY, GYNECOLOGY AND OBSTETRICS, page 30, Dr. J. Clark Stewart of Minneapolis contributes a paper entitled, "The Malignancy of Giant-celled Sarcoma."

I was especially attracted by the criticism contained in this article of a paper published in the *Annals of Surgery*, February, 1913, entitled "Chronic (non-suppurative) Hæmorrhagic Osteomyelitis."

Synonyms: (*a*) Medullary giant-cell sarcoma.
(*b*) Myelogenous giant-cell sarcoma.
(*c*) Myeloma.
(*d*) Medullary giant-cell tumor (Bloodgood).

As your correspondent is the author of the paper referred to, he feels that not to reply would appear like giving assent to Dr. Stewart's conclusions.

Whether or not the diagnoses made in the cases reported in the *Annals of Surgery* were "justified" must rest upon the records published therein.

The clinical evidence obtained and noted of the first case reported is fairly typical of what has heretofore been described as slow growing medullary giant-cell sarcoma occurring as a single lesion in the ends of the long bones.

The gross pathologic picture of this case was absolutely typical.

The writer does not know of any other gross lesion of bone where the naked eye appearance of the mass is so uniform and clear.

If one sums up the clinical, X-ray, and gross pathologic pictures these lesions exhibit, the evidence is ample to give a positive and conclusive diagnosis.

The histo-pathologic picture adds cumulative evidence, but to the modern surgeon does not begin to have the value that the gross appearance of the lesion properly interpreted presents.

The microscopic examination was made in the first case as a matter of routine, not because it seemed necessary to confirm the diagnosis. It was confirmatory, however, of the diagnosis made.

In Case No. III, the specimen sent for microscopic examination to the laboratory was mislaid.

The statement that in one case the diagnosis was made from the skiagraphic picture alone is a mistake. The diagnosis was reached in this case in connection with the clinical picture obtained

and the X-ray findings. Since this case was reported, the patient submitted to operation and the diagnosis has been verified, macroscopically and microscopically.

It is not so "unique" as the Doctor may imagine to make fairly accurate diagnoses from X-ray plates if he could realize that in one institution we have the opportunity of studying the plates of over fifteen hundred cases annually of bone and joint lesions alone.

Dr. Stewart states that from the description given of these cases that they "tally exactly" with cases he described as non-suppurative osteomyelitis at the Western Surgical Society in December, 1910.

I have looked up the article referred to and also find the same paper given more in detail in the *New York Medical Journal*, March 25, 1911.

After a careful reading of this paper I am quite unable to see wherein the cases reported by Dr. Stewart "tally" with those reported by me.

It seems to your correspondent that a comparison of both papers clearly shows an altogether different line of reasoning, thought, conclusion, and different case reports.

The term "non-suppurative osteomyelitis" was first made use of by Ollier, and frequently since by different authors for various bone lesions.

I am not aware that the term "chronic (non-suppurative) hæmorrhagic osteomyelitis" has been previously given to any bone lesion, or the belief advanced, that the so-called slow growing medullary giant-cell sarcoma occurring as a single lesion in the ends of the long bones is simply a hæmorrhagic form of osteomyelitis, exhibiting excessive formation of exuberant embryonal vascular granulation tissue replacing destroyed cancellous structure.

Referring to the two cases reported by Dr. Stewart under the title, "The Malignancy of Giant-celled Sarcoma," SURGERY, GYNECOLOGY AND OBSTETRICS, July, 1913, page 30, it seems to the writer from the description and evidence given that a more correct designation for the lesions would be mixed cell and spindle cell sarcomata, respectively.

Yours truly,

GEORGE BARRIE.

New York City.

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# ABDOMINAL, OR EXTRA-UTERINE, PREGNANCY WITH LIVING CHILD

BY J. SHELTON HORSLEY, M. D., RICHMOND, VIRGINIA

In December, 1912, I read an article entitled "Abdominal Pregnancy with Living Child" before the Southern Surgical and Gynecological Association, reporting a case and showing the mother and child. The article was published in the July number of SURGERY, GYNECOLOGY AND OBSTETRICS, 1913. An attempt was made to bring the literature on this subject down to January, 1912. The material for this part of the paper was obtained through some one in Washington, D. C., who searches the literature in the Surgeon-General's Library. Since the paper was published I find that only the literature listed in the Index Medicus under "abdominal pregnancy" was reported to me. Consequently, a great many cases which have appeared from 1897 to 1912 have been overlooked because they were listed under "ectopic," or "extra-uterine pregnancy" and not under "abdominal pregnancy." The term "abdominal pregnancy" was used in the broad sense meaning a pregnancy that developed and came to full term, or nearly full term, within the abdominal cavity and outside of the uterus. The following are references that were omitted:

First of all there are 14 cases reported by A. Sittner, published by him in *Arch. f. Gynäk.*, Berl., 1907–1908, lxxxiv, 1–95. Sittner's own case has been referred to as Case No. 7 in my previous article.

CASE 1. Bonckiser, A., Karlsruhe, February, 1899, personal communication. Aet. 23 years, III-para. Last confinement 14 months ago. Mother recovered. Child, male, 3240 gm., 48 cm., still living.

CASE 2. Fischer, A., Tiflis, March 3, 1900, Russk. Vrach., 1903, No. 3. Aet. 20 years, II-para. Mother died 48 hours later from acute anæmia. Child, female, 2800 gm., 50 cm., well formed and was delivered alive.

CASE 3. Pasquali, E., Rome, January 27, 1901, Policlin., 1903. Aet. 25 years, primipara. Mother recovered. Child was poorly developed, lower extremities deformed, lived 24 hours.

CASE 4. Lentz, December 26, 1901, Dissertation, Strasburg, 1902. Aet. 27 years, II-para. Mother recovered perfectly. Child lived 20 minutes.

CASE 5. Fischer, A., Tiflis, October 4, 1902, Russk. Vrach., 1903, No. 3. Aet. 26, II-para. Mother recovered.

Child, male, 2420 gm., 46 cm., perfectly formed and lived two years.

CASE 6. Calderini, G., Bologna, June 12, 1903, Atti d. Soc. Ital. di ostet. e ginec., 1903, iv. Aet. 40 years, V-para. Woman made a perfect recovery. Child, female, 3500 gm., still living.

CASE 7. Schmit, H., Linz, July 17, 1903, Wien. klin. Wchnschr., 1904, No. 19. Aet. 32 years, III-para. Mother made a perfect recovery. Nine days after operation the decidua passed. Child, male, 2550 gm., 45 cm., perfectly formed, still living.

CASE 8. Olshausen, R., Berlin, October, 1903, Ztschr. f. Geburtsh. u. Gynäk., No. 52, 2. Aet. 27 years, V-para. Mother died 24 hours after from collapse. Child, female, 3880 gm., 50 cm., with deformity of the left side of face. This disappeared after eight months and child still living.

CASE 9. v. Guerard, Disseldorf, 1903, personal communication. Aet. 42 years, V-para. Patient did well for two days, when she got up, which brought on a renewed hæmorrhage, from which she died. Child, well formed, died several days after birth from lack of proper attention.

CASE 10. Popoff, D., St. Petersburg, September, 1904, Russk. Vrach., 1905, Nos. 27–29. Aet. 20 years, III-para. Patient made uninterrupted recovery. Child, male, 2975 gm., 49 cm., had pes equino-varus; lived 15 months. The case was one of left-sided ovarian pregnancy.

CASE 11. Michin, P. W., Charkow, January 6, 1905, Russk. Vrach., 1905, No. 12. Aet. 38 years, IV-para. Mother recovered. Child, male, 2420 gm., 42 cm., lived one month.

CASE 12. v. Ott, St. Petersburg, January 27, 1905, personal communication. Aet. 36 years, II-para. Mother recovered slowly on account of complications. Child, female, 2900 gm., was living four months after.

CASE 13. Landau, T., Berlin, March 29, 1905, Deutsche med. Wchnschr., 1906, No. 30. Aet. 34 years, II-para. Mother recovered but had thrombosis of the left leg. Child, male, 3250 gm., 46 cm., still living.

CASE 14. Jerie, J., Prag., September 12, 1905, Časop. lék. česk., 1906, 913. Aet. 37 years, V-para. Mother made a slow but complete recovery. Child, female, 3700 gm., 47 cm., deformed in face and head with pes equino-varus; luxation of left hip joint; is still living.

CASE 15. Dalton, H. C., Am. J. Surg. & Gynec., 1898–99, xi, 91. Case of ectopic pregnancy operated upon at full term. Aet. 27, 1 child 8 years old, no miscarriages. Mother made a tedious, but complete recovery. The child lived four hours.

CASE 16. Rafferty, T. N. and H. N., Med. Rec., 1901, lx, 472. Case ectopic gestation in patient 34 years, always well up to present trouble. Mother was in a bad condition up to her death six days after operation. The child lived 13½ hours.

CASE 17. Root, E. F., Am. J. Surg. & Gynec., 1902–03, xvi, 204. Aet. 40, at full term and supposed to be in labor with regular pains. Mother died 28 days after from sepsis. The child lived four days.

CASE 18. Peham, H., Wien. klin. Wchnschr., 1904, xvii, 527. Aet. 34. The mother was in a desperate condition for five days, but recovered completely in six weeks. The child, female, was perfectly developed and is living.

CASE 19. Czyzewicz, A., Zentralbl. f. Gynäk., 1904, xxviii, 97. Child lived a short time as it was deeply asphyxiated. Mother died four days later from pneumonia.

CASE 20. Landau, T., Berl. klin. Wchnschr., 1906, xliii, 1061. Aet. 39, had had four children, normally, the last 8 years ago. Child, female, 38 cm. long, weight 1300 gm., wry-neck on left side. Mother recovered easily.

CASE 21. Adjaroff, C., Wien. klin. Wchnschr., 1907, xx, 1614, reports case of full-term ectopic gestation in a woman, aet. 33, who had had four normal births and two miscarriages. Mother and child perfectly well two years later and the child is normal in every respect.

CASE 22. Rosenberger, A., Pest. med-chir. Presse, 1907, xlii, 570. Aet. 22, in her first pregnancy, admitted to hospital with diagnosis of extra-uterine gestation with living child. Recovery uneventful, mother and child (male) left the hospital on the 21st day.

CASE 23. Ectopic gestation with viable child. Report of three cases. By X. O. Werder, Am. J. Obst., N. Y., 1908, lviii, 796. The first case, aet. 35, was admitted to hospital January 23, 1894, when the diagnosis of extra-uterine pregnancy with living fœtus of six months was made. The child, though considerably deformed, was strong and showed considerable vitality, did well for two days, but died four days after delivery from probable pneumonia. Mother recovered.

CASE 24. Aet. 24, married four years, had one child 21 months ago, with easy labor. Patient died two days later as a result of shock. Child's arms and legs slightly deformed; it was small, feeble and lived only a few hours.

CASE 25. Aet. 30, admitted September 10, 1907, with diagnosis of ectopic pregnancy at about six months. The child, female was deformed, but no statement is made whether or not it was living when delivered.

CASE 26. Hornemann, S., Zentralbl. f. Gynäk., 1908, xxxii, 668. Aet. 25, II-para, admitted November 12, 1907. The child, which was deformed, lived four hours. Mother recovered and left hospital 34 days after operation.

CASE 27. Campione, F., Arch. di ostet. e. ginec., Napoli, 1908, i, 647. Aet. 37. Mother made an uninterrupted recovery. Child at birth weighed 3470 gm.; 5 months later 6200 gm.

CASE 28. Blesh, A. L., and Reed, H., J. Am. M. Ass., 1908, l, 2137. Mulatto, 24, had one child aet. 3. Mother left hospital in four weeks with the placenta not yet detached. She returned four weeks later when the placenta was removed without hæmorrhage. Is in good health eight months later and child weighs 18 pounds.

CASE 29. Potocki, Gynécologie, Par., 1908, xii, 175. Extra-uterine pregnancy at term with living child. Aet. 23 years. Mother made an uneventful recovery. The child, female, did well for six months, when she began to have convulsions and paralysis of the lower extremities followed. At 2½ years she is alive, but is deaf and dumb.

CASE 30. Rathe, B., Dissertation, Leipzig, 1909. Case of extra-uterine pregnancy at the ninth month with living child. Aet. 29. The patient did well for six days when she was suddenly seized with a severe attack of embolism and died in a few minutes. The child lived one hour.

CASE 31. Greenberg, H., J. Am. M. Ass., 1910, liv, 1517. Extra-uterine pregnancy at full term. Aet. 28, married 3 years, I-para. The woman made an uneventful recovery. It is not stated how long the child lived.

CASE 32. Calloway, I. M., N. Orl. M. & S. J., 1912, lxiv, 641. Extra-uterine abdominal pregnancy (primary). Aet. 26. Mother and child both well and were presented to the Louisiana State Medical Society at their meeting.

CASE 33. J. N. Warren, N. Y. M. J., 1909, May 1. Aet. 34. Patient recovered. Child lived 10 hours.

These statistics alter the situation very considerably and greatly lessen the mortality rate of the mother and increase the number of children who have remained well for a year or more after the operation. The total number of extra-uterine pregnancies with living child at or near full term is 138 to January, 1912. Of these, 46 have been reported since 1897.

# BOOK REVIEWS

A Treatise on Tumors. By Arthur E. Hertzler, M. D., Ph. D. Philadelphia and New York: Lea & Febiger.

The book is well written; the descriptions, while brief, are clear. The subject matter is well arranged and the ease with which the book may be read, together with the numerous well chosen illustrations, should make this work an extremely interesting and practical treatise for students and practitioners alike.

The work is divided into three parts, the first being devoted to a brief discussion of the general biology of tumors, etiology, classification, structure and metastasis.

In the second part the author discusses the general pathology of the various tumors, their macroscopic and microscopic appearances, diagnosis, prognosis and treatment.

The third and largest portion of the work is devoted to an excellent presentation of the more clinical aspects of tumors by special regions. This part of the work is profusely illustrated by original illustrations of cases from the author's practice and deserves the highest commendation for both the author and the publishers. F. R. Zeit.

The Catarrhal and Suppurative Diseases of the Accessory Sinuses of the Nose. By Ross Hall Skillern, M. D. Philadelphia and London: J. B. Lippincott Company.

This work, the first on the subject in English, except that of Turner of London, deserves careful study by those interested in the accessory sinuses, on account of its scientific thoroughness and the painstaking care with which it has been prepared. It treats not only one or two phases of the subject but aims to cover the whole ground, beginning with the surgical anatomy and physiology of the nose and devoting much space to the pathology, diagnosis and treatment, surgical and otherwise, complications, etc. Especial stress is laid on the treatment of sinusitis in general and of the individual sinuses separately. Space permits mentioning only a few of the many admirable points of the work. Under the heading of the ethmoid labyrinth a new classification of pathological conditions is attempted and seems satisfactory. A valuable characteristic is the minute detail into which the author goes in his elaboration of the technique of the various operations, not only in the text but in the great number of excellent original illustrations. It is very valuable as a bibliography as there are nearly six hundred references arranged in the form of footnotes. These show the careful study and reading that was necessary to produce the work, due credit thus being given for all literature consulted. It is a thoroughly practical book, more so perhaps than any of the German works on accessory sinuses and is a book for the specialist on account of its thoroughness and accuracy. At the same time it is so simply written that a beginner has little difficulty in following the descriptions, so well amplified with illustrations. The manuscript has been corrected and revised by Prof. George F. Martin and shows the result of his work, although the number of typographical errors usually found in first editions are present.

George M. Coates.

Gonorrhœa in Women. By Charles C. Norris, M.D. Philadelphia and London: W. B. Saunders Company.

Dr. Norris has written a very complete volume on a subject seldom handled in just this manner. It would seem that such a volume is needed, especially among the physicians of the more densely populated districts where the Neisserian infection is so prevalent. The book as a whole is comprehensive, including some few chapters, especially those on sociology and prostitution, that would not occur on first thought to the average man of the profession as belonging to a text of this character.

It is hardly necessary to state that the opening chapter dealing with the history of gonorrhœa is interesting, and insofar as the reviewer is able to corroborate them, the historical facts and dates are reliable.

The chapter on bacteriology and pathogenesis is an able laboratory manual. One cannot speak too highly of the excellent work Dr. Norris has done on this most important subdivision of the subject. Cultural methods, staining, morphology, pathogenesis, virulency and bacteriological diagnosis are all expounded with the finesse and simplicity of a master.

The sociological aspects of the disease, gonorrhœa as a cause of abortion, sterility and the destruction of eyesight in the newborn, are discussed. Statistics are carefully compiled, demonstrating the serious effects of the disease upon the given individual, and more especially, its destructive influence upon the general civic body.

Under the head of prophylaxis, the methods of preventing dissemination of the disease are presented. We are told of the conditions in the United States Public Health and Marine Service. The wonderful value of prophylaxis here shown will

be a revelation to a large number of readers. A chapter is devoted to approved methods of examination and of the means of ascertaining with certainty the presence of the gonococcus. The necessity for ascertaining when a cure has been effected is also dwelt upon.

One of the most important subdivisions of a book of this character should be the one devoted to pathological changes. A criticism might be made of this volume in that Dr. Norris has dwelt too lightly and briefly with this subdivision of his subject. In tracing the pathological changes incident to this infection, Dr. Norris begins with the external genitalia and follows the process through the generative tract to the ovaries and tubes.

There is a chapter on operative methods of treatment, and in this chapter conservatism is the rule, with a caution to exhaust all medical treatment before surgical intervention is undertaken. The chapters on diffuse gonorrhœal peritonitis and on gonorrhœa during pregnancy, parturition and the puerperium are of great importance.

The final chapter deals with the medical treatment of gonorrhœa and is very complete. Comparative study of results obtained by various methods of treatment gives opportunity to present to the profession that which has proven best. The relative value and the present status of the serum and vaccine treatments are also considered.

THE EVIL EYE. By Roswell Park, M. D. Boston: Richard G. Badger, Gorham Press, 1912.

Members of the medical profession incline more and more to turn aside from the straight path of technical investigation and scientific writing to wander for short periods in the Elysian fields of a less exacting literature. It is by no means wonderful that a great force should lure one to fields that are spangled with such bright names as Osler and Paget, Holmes and Weir Mitchell. For these the outpouring of soul has been a necessary delight, but it has also been an honor to the profession and an ornament to literature.

One of the latest to resort to this form of intellectual recreation is Roswell Park, the Buffalo surgeon. His new book, which takes its title from the first paper therein, shows the great breadth of the interests that concern him and the unusual variety of subjects to which his investigations have led.

That a doctor should be interested in thanatology is a necessity which has been recognized by many others than the author of "Religio Medici," and phallic worship through the medium of serpents and monuments is too closely allied to folklore to evade for long the search of the medical historian. Indeed Ploss and Bartels' "Das Weib," Fraser's "Golden Bough," and many other compendiums of strange literature and bygone superstitions are to be found in many professional libraries.

These subjects are really part of a liberal education in medicine, and as such come to all who have the leisure to indulge their generous inclinations.

It is only when we consider such other topics as iatrotheurgic symbolism, the Knights of St. John, Giordano Bruno, and the relation of the Grecian mysteries to Christiantiy, that Dr. Park's wide reading, catholic interests, and literary industry really become manifest.

The author has collected in small compass, almost too small, a vast amount of curious and valuable information. In his critical attitude toward the various superstitions of the past he maintains the only position possible to the scientist, while his acute sympathy for those who have fallen victim to the ruthless agents of fanaticism is equally in accord with the human and truly Christian feelings of the modern materialist who has shed his provincial and restrictive orthodoxy.

Student life in the Middle Ages, the evolution of the surgeon, and the discovery of the circulation are other topics of more than usual excellence.

The matter is interesting, is well digested, and pleasingly presented. The book should be a welcome relief to the brethren whose eyes are fatigued and whose minds have been temporarily anæsthetized by too rigorous application to professional subjects.

C. B. REED.

THE PRINCIPLES AND PRACTICE OF OBSTETRICS. By Joseph B. DeLee, A. M., M. D. Philadelphia and London: W. B. Saunders Company, 1913.

In 1807 appeared the first American textbook on obstetrics, written by Samuel Bond of the College of Physicians and Surgeons in the University of the State of New York. This was entitled A Compendium of the Theory and Practice of Midwifery, containing practical instruction for the management of women during pregnancy, in labor and in childbed, illustrated by many cases and particularly adapted to the use of students. Professor Bond was a conservative teacher of experience and largely confined himself, as he says in his introduction, to "teaching the great resources of nature and delivering such rules and precepts as would in the first place prevent all unnecessary interference with her efforts."

Since the publication of this work our students and practitioners have not wanted good textbooks on obstetrics. We recall those of Dewees, Hodge, Meigs, Lusk, Parvin, not to mention the more recent well-known works of Hirst, Williams, Edgar, Davis and others, as well as the several excellent systems written by the co-operation of the numerous teachers of the country. Many of these books have been characterized by the well marked individuality of the authors. The earlier books drew most of their scientific facts and many of the rules of practice from English and French sources. Those of the last thirty-five years have drawn more from Germany, which has in this period been the Mecca of our students.

The work before us is worthy to stand with the best American textbooks. The author has also had German training and is imbued with the best

German ideals and methods. He is, however, also well acquainted with the English, French, Italian, and Russian literature and practice and gives us a book up to date in its presentation of the science of obstetrics.

The characteristic of the book, however, is its practicability. With great attention to detail he presents the management of pregnancy, labor and child-bed so that there can be no misunderstanding. In this he profits by his long years of service in building up the Chicago Lying-In Hospital and Dispensary and by the experience gained there in training internes, students and nurses. Like our first American obstetrician, Bond, he starts out with a decided conservative trend which he preserves throughout. The responsibility of the obstetrician is kept constantly in view and the dignity of the specialty is consistently and persistently urged.

The practical character of the book is shown in the first three sections, which consider the physiology of pregnancy, labor and the puerperium, in which the practical bearing of the physiological processes and changes is constantly noted. We especially commend the concise description, nomenclature and the clear presentation of the important subject of mechanism of labor. As an illustration of the completeness of the work we note that the author calls attention to the importance of determining the degree of engagement of the presenting part, a subject generally overlooked in textbooks.

The section on the hygiene and conduct of pregnancy and labor can be commended with little or no reserve. The clear descriptions, the exact directions and the beautiful illustrations make this section very attractive to the reader. Only one or two minor criticisms of details might be made. While the author does not subscribe to the theory of maternal impressions, he seems to regard it with some indulgence when he makes the fanciful suggestion that certain monstrosities may be caused by the action on the egg of toxins produced in the mother by emotions.

Whether there is a sufficient superiority of aboline to the official preparation of petrolatum to justify its specification as an application to the nipple and incidentally its extensive advertising is a question. The ingenuous recommendation of proprietary preparations has brought much discredit on the medical profession. The work of the official board of the American Medical Association has made it possible to get reliable information concerning these preparations and any article not approved by this council should be recommended with some hesitation. This remark would apply equally well to "lysol."

We would suggest the name aspirating catheter, instead of tracheal catheter, for the instrument used in extracting mucus from the child's throat. Rarely or never is it necessary to pass the catheter through the larynx and the name should not give a mistaken idea of its use.

In one instance the word infected is probably inadvertently used for contaminated in the statement that during pregnancy "the vulva is always infected with nonpathogenic and pathogenic bacteria."

In the rules for the conduct of the third stage of labor it is directed to draw the cord up over the thigh leaving a loop hanging just so it touches the bottom of the basin which is pushed up against the perineum. Why should not the cord be cut off at the vulva permitting the placental end to slip back into the vagina and allowing the application of a sterile vulvar pad?

The reasons given for prohibiting a tub bath to the child until the umbilicus is healed will hardly seem satisfactory to all. With this exception the section on the physiology and care of the child is a model for conciseness and practicability.

Hyperemesis gravidarum is classed among the toxæmias and as such is considered as a distinct disease entity. The author does not agree with Williams that the toxic form can be diagnosed by the ammonia coefficient. The rules of treatment are conservative and give evidence of much experience. The difficult subject of induction of abortion is handled as well as the present state of diagnosis and prognosis allow.

In discussing Williams' rule to empty the uterus when vomiting is toxic the author says that "a positive diagnosis of toxæmia cannot always be made and too many cases of toxæmic vomiting recover under the usual treatment."

In the treatment of eclampsia the rapid emptying of the uterus in deep narcosis after the first convulsion is preferred. The danger of narcotics and especially chloroform and morphine is emphasized. Elimination is said to be disappointing and hot baths and packs are disapproved. Venesection is spoken of favorably while decapsulation of the kidney is condemned.

The important subject of differential diagnosis of extra-uterine pregnancy is discussed fully and the treatment shortly summarized by recommending operation.

The chapter on displacement of the uterus complicating pregnancy is unusually complete. Abortion in progress, associated with hæmorrhage, is treated by tampon, generally followed by a careful curettement. In septic abortion not complicated with hæmorrhage it is generally best to adopt an expectant course and avoid the curettement.

In *abruptio placentæ* or premature separation of the normally seated placenta, the treatment recommended is rupture of the membranes, insertion of a metreurynter and the application of an abdominal compression bandage in case the cervix is not sufficiently dilated to admit of extraction with forceps or craniotomy. If conditions permit, abdominal or vaginal Cæsarean section may be done.

The author's positive stand in favor of terminating pregnancy in placenta prævia is very desirable considering the reckless indifference of many physicians when consulted for hæmorrhage during

pregnancy. He insists that all cases should be sent to a hospital. He carefully indicates what cases may be treated by rupture of the membranes, by version, and by metreurysis. The technique of these operations is given in detail. The propriety of Cæsarean section for selected cases is admitted.

Multiple pregnancy is classed among the pathological conditions because of the disturbance of pregnancy, the great number of pathological labors, the great danger of infection and hæmorrhage and the bad prognosis for the children. The chapter on the acute and chronic diseases and the neoplasms complicating pregnancy, as well as those on the diseases of the ovum and membranes, are concisely handled with satisfactory fullness and clearness.

In the most commendable section on the pathology of labor, attention may be called to a few points where some difference of opinion might arise. In the enumeration of the causes of O. P. position, the failure of flexion and the lack of an efficient resisting pelvic floor are not emphasized as much as some might desire. Likewise the dismissal of the method of manual rotation because inefficient would not receive assent. The technique of delivering the impacted breech is not given in sufficient detail.

In general, the entire subject of dystocia is treated most fully and clearly. Especial attention is called to the chapter on injuries to the parturient canal.

The subject of puerperal infection receives adequate consideration. The conservative management is advised, local treatment being practically dispensed with.

The last tenth of the book is given to obstetrical operations. The general considerations are most praiseworthy. The preparatory operations are especially well described and illustrated. The indications for low forceps are somewhat more lenient than some would wish. The author is in sympathy with the modern tendency to enlarge the field for Cæsarean section. The extra-peritoneal section is described but not recommended.

The book is one that can be recommended to students as a full presentation of the science of obstetrics and a safe guide in the practice of the art. It is especially valuable to the physician who has not kept up to date in the recent progress in this field. It is worthy to name as representing American scholarship and professional progress.

CHARLES S. BACON.

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## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LEHRBUCH DER PRAKTISCHEN CHIRURGIE FÜR ÄRZTE UND STUDIERENDE. Vols. I and II. By Drs. L. Gelpke and C. Schlatter. Price, 40 marks. Leipzig, Germany: Johann Ambrosius Barth.

MANUAL OF OBSTETRICS. By John Osborne Polak, M. Sc., M. D. Price $3.00 net. New York and London: D. Appleton & Company.

THE PRACTICAL MEDICINE SERIES. Vol. IV. Gynecology. Edited by Emilius C. Dudley, A. M., M. D., and Herbert M. Stowe, M. D. Price $1.35. Chicago: The Year Book Publishers.

PRÉCIS DE RADIOLOGIE PRATIQUE. By André Lomon and Camille Hahn. Price 9 francs. Paris, France: Société d'Editions Scientifiques et Medicales.

MANUAL OF SURGERY. Third edition. By Francis T. Stewart, M. D. Price $4.00 net. Philadelphia: P. Blakiston's Son & Company.

1870–71 GRINNERUNGEN UND BETRACHTUNGEN. By Prof. Dr. Heinrich Fritsch. Bonn, Germany: A. Marcus & E. Weber.

MARRIAGE AND GENETICS. By Charles A. L. Reed, M. D. Price $1.00. Cincinnati: The Galton Press.

SYPHILIS AND THE NERVOUS SYSTEM. By Max Noones, M. D. Translated from the second edition by Charles R. Ball, B. A., M. D. Price $4.00. Philadelphia: J. B. Lippincott Company.

THE SURGERY OF THE STOMACH. A Handbook of Diagnosis and Treatment. By Herbert J. Paterson, M. A., M. B., F. R. C. S. Price $3.50. New York: William Wood & Company.

AN INTRODUCTION TO THE STUDY OF INFECTION AND IMMUNITY. Including Serum Therapy, Vaccine Therapy, Chemotherapy and Serum Diagnosis. By Charles E. Simon, M. D. Second edition, thoroughly revised. Price $3.25 net. Philadelphia and New York: Lea & Febiger, 1913.

ANATOMY, DESCRIPTIVE AND APPLIED. By Henry Gray, F. R. C. S. New (American) edition, thoroughly revised and re-edited, with the ordinary terminology followed by the Basle anatomical nomenclature, by Edward Anthony Spitzka, M. D. Price $6.00 net. Philadelphia and New York: Lea & Febiger, 1913.

PRACTICAL MEDICINE SERIES. Vol. II. General Surgery. Edited by John B. Murphy, A. M., M. D., LL. D. Price, $2.00. Chicago: The Year Book Publishers.

COLLECTED PAPERS BY THE STAFF OF ST. MARY'S HOSPITAL (Mayo Clinic) 1912. Price $5.50 net. Philadelphia and London: W. B. Saunders Company, 1913.

DISEASES OF THE RECTUM AND PELVIC COLON. By Martin L. Bodkin, M. D. New York: E. B. Treat & Company.

MINOR AND OPERATIVE SURGERY, INCLUDING BANDAGING. By Henry R. Wharton, M. D. Eighth edition. Price $3.00 net. Philadelphia and New York: Lea & Febiger, 1913.

MECHANICAL TREATMENT OF ABDOMINAL HERNIA. By William Burton DeGarmo, M. D. Price $5.00. Philadelphia: J. B. Lippincott Company.

A TEXTBOOK OF MIDWIFERY. By R. W. Johnstone, M. A., M. D., F. R. C. S., M. R. C. P. E. New York: The MacMillan Company.

THE CHILD. By E. Mather Sill, M. D. New York: Henry Holt & Company.

LABOUR-ROOM CLINICS. By V. B. Green-Armytage. M. D. London: W. Thacker & Company.